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# ANNALES MEDICINAE EXPERIMENTALIS ET BIOLOGIAE FENNIAE

REDACTORES:

E. MUSTAKALLIO  
(TURKU)

U. UOTILA      ARMAS VARTIAINEN  
(HELSINKI)      (HELSINKI)

A. WILSKA      A. I. VIRTANEN  
(HELSINKI)      (HELSINKI)

EDITOR

K. O. RENKONEN

REDIGENDOS CURAVIT

ODD WAGER

ORNITHOSIS IN HELSINKI  
AND SOME OTHER LOCALITIES IN FINLAND

A Serological and Clinical Study

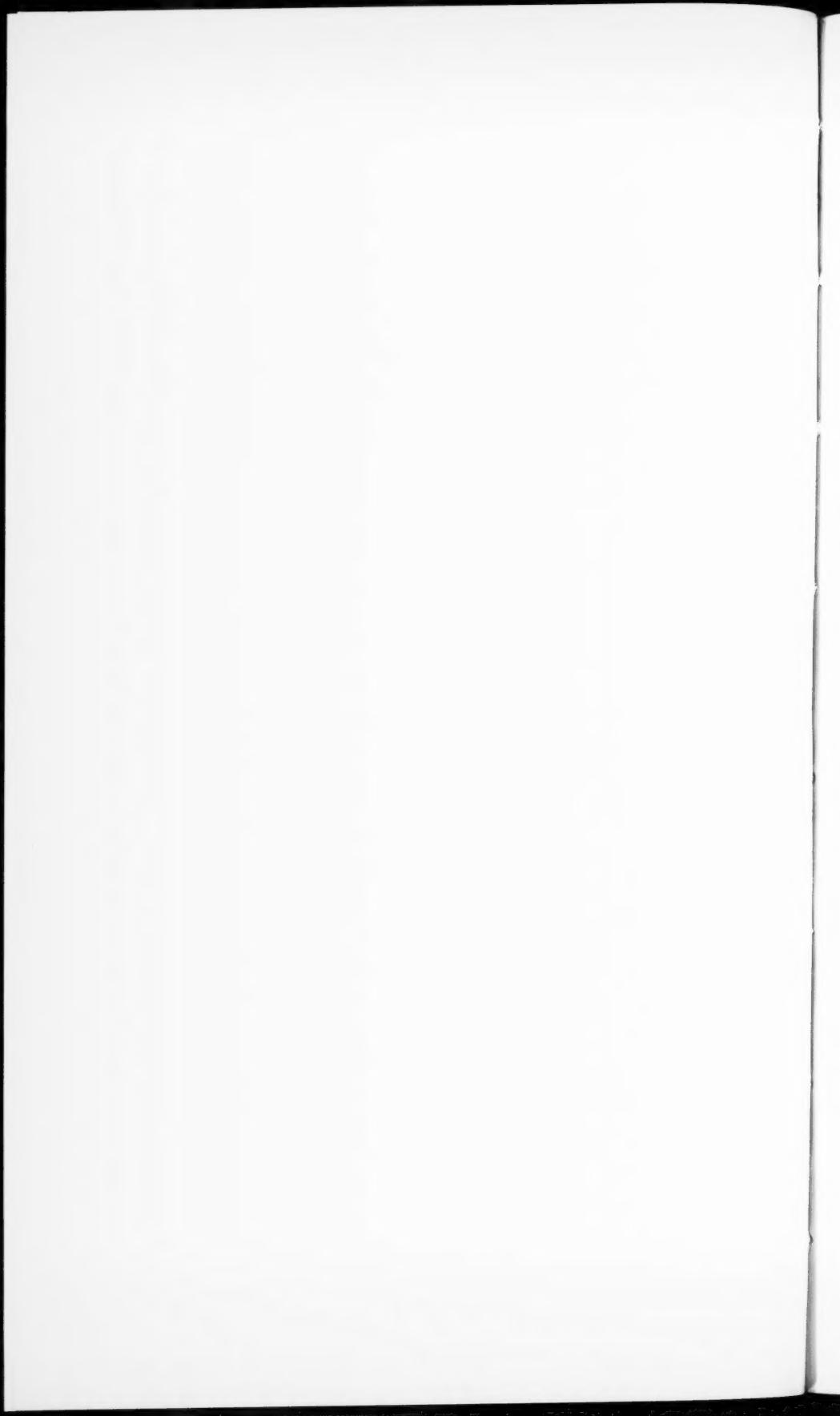
BY  
ELLI JANSSON

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MERCATORIN KIRJAPAINO  
HELSINKI, FINLAND



FROM THE MUNICIPAL BACTERIOLOGIC LABORATORY, AURORA HOSPITAL, HELSINKI

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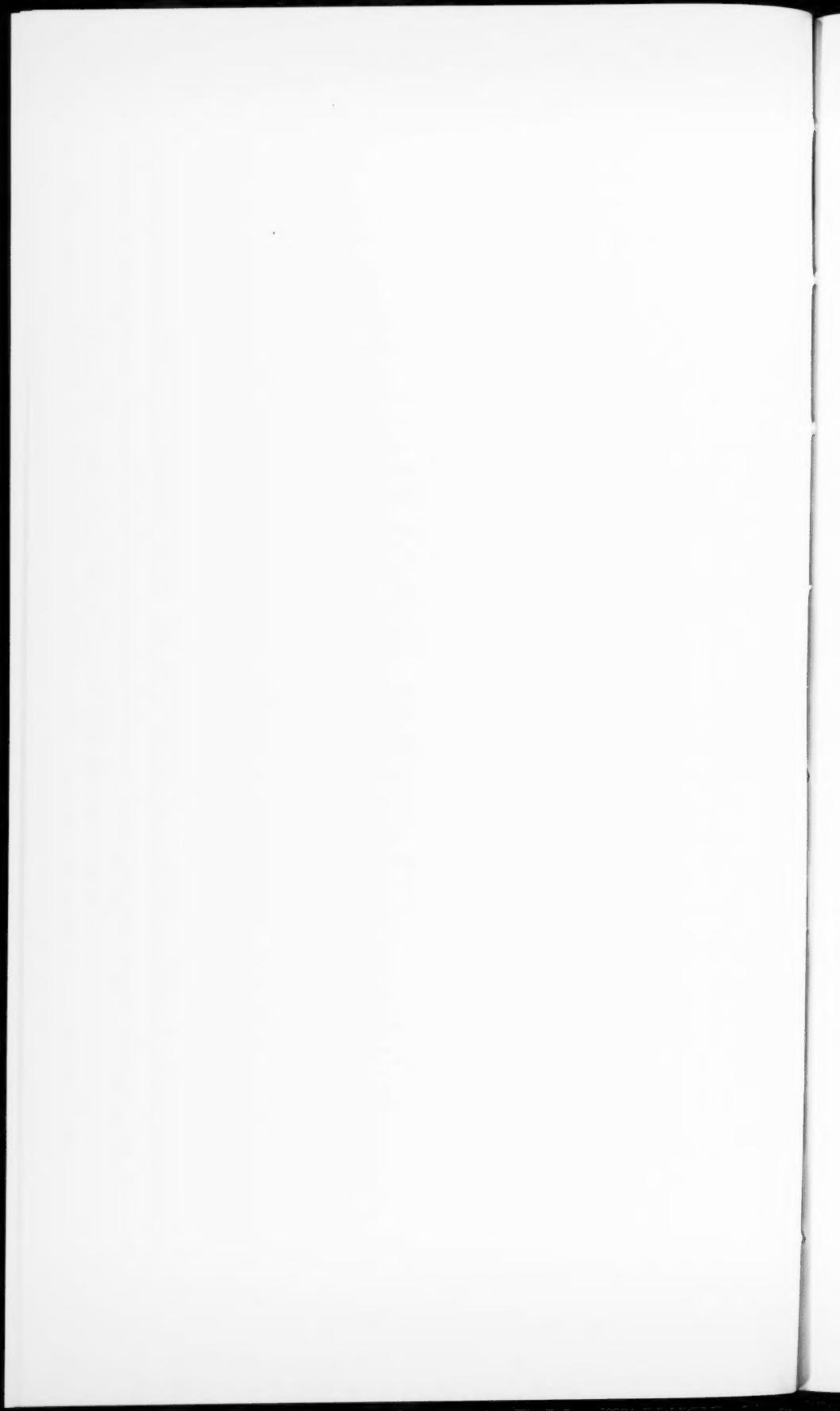
BY  
ELLI JANSSON

HELSINKI 1960

*Translated by*  
*Elvi Kaukokallio*

**HELSINKI 1960**  
**MERCATORIN KIRJAPAINO**

*to my parents*



## PREFACE

This investigation was carried out in the period October 1958--May 1960 in the Municipal Bacteriologic Laboratory, Aurora Hospital, Helsinki.

The head of the laboratory, Odd Wager, M. D., suggested to me the subject of the investigation. He has shown great interest in my work on the occurrence of ornithosis and has supported it with valuable guidance in its various stages. It is a pleasure for me to express my sincere gratitude to Dr. Wager.

I extend my thanks to Kari Penttilä, M.D., head of the Virologic Department of the State Serum Institute, for his expert advice in the work and for permission to prepare a supply of antigen in his department.

The favorable consideration towards this investigation shown by Professor Erkki Klemola, M.D., and Per Forssell, M.D., heads of the adults' and children's Epidemic and Medical Departments of the Aurora Hospital, made it possible for me to collect from these departments the greater part of the material for this study. I am greatly indebted to them for this. My thanks are also due to Dr. Rasmus Stenström, head of the Department of Roentgenology of the Aurora Hospital, for interpretation of the chest x-rays of the patients. I also wish to extend cordial thanks to all my colleagues in this hospital for assistance willingly given in the course of my work.

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Through the courtesy of a number of colleagues in other regions of Finland I received additional blood samples for use in this work. I wish to thank especially Dr. Kalle Hällström, of the Serologic and Bacteriologic Laboratory of Lappeenranta, Dr. Jaakko Manner, of the Pyynikki Hospital in Tampere, Heikki Kalliala, M.D.,

of the Vaasa Central Hospital and Dr. Ritva Sunila, of the Lapland Children's Hospital in Rovaniemi.

The study of ornithosis in pigeons would not have been possible without the generous help of the City Disinfection Plant of Helsinki, where I wish to thank particularly Captain Y. Väisänen and Mr. O. Borgsten.

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I take pleasure in thanking also personal friends who have been helpful to me in my carrying this work to completion.

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Helsinki, July 20, 1960.

E. J.

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## CHAPTER I

### REVIEW OF THE LITERATURE

Ornithosis is a disease originally occurring in birds, which on being transmitted to man produces a respiratory tract infection varying from a mild common cold to severe pneumonia. When encountered especially in parrots the disease is also called psittacosis; this term is still used occasionally as a synonym of ornithosis. In the International List of Diseases ornithosis has been approved as the general term. The disease was first described by the Swiss physician Ritter in 1879, and the etiologic agent was discovered in 1930 by Bedson, Western and Simpson (5).

The etiologic agent of ornithosis is included in the group of largest viruses, although in certain respects it resembles Rickettsiae. To the same category belong the viruses of lymphogranuloma venereum and trachoma as well as certain viruses pathogenic to animals, such as the mouse meningopneumonitis virus (38), mouse pneumonitis virus (92), bovine encephalomyelitis virus (135) and bovine pneumonitis virus (97). Certain species pathogenic to animals may occasionally produce disease also in man (4).

Ornithosis has been encountered in 98 avian species, especially in parrots, canaries, pigeons, hens and turkeys, but also in small birds such as swallows and finches. It is a fairly common disease in birds; thus ornithosis antibodies were found in 25 per cent of examined, clinically healthy pigeons in Hamburg and Jerusalem (9, 130), and in as many as 63 per cent in some parts of the United States (80). In birds the course of the disease usually is chronic and benign, and it takes a more severe course only on impairment of the animal's general physical condition, for example incident to migration or shipment or due to poor availability of food. The excreta of an infected bird contain a large number of viruses and the infection is transmitted to man by air or contact.

The classical concept of ornithosis essentially includes an established contact with birds. Cases have been reported especially

among bird dealers, owners of cage birds, and poultry raisers. Occasionally, however, no contact with birds could be established. This, as well as the fact that the disease often is endemic, occurring in families, among hospital personnel and in military units, points also to interhuman transmission. It is probable that infection from man to man is common. Possibly there exist a number of different strains of ornithosis virus, some of which have become adapted to man. For example, in the early 1940's epidemic pneumonia due to the ornithosis virus or a related agent was reported in San Francisco, Louisiana and Illinois, but no contact with birds could be established (28, 94, 95, 96, 137). In one-half of 508 cases of ornithosis diagnosed in the United States in 1956 the source of the disease could not be determined (108). The psittacosis virus contracted from parrots or canaries produces the most severe clinical features in man, whereas ornithosis transmitted by pigeons is, according to the general opinion, usually much more benign (88). The ornithosis virus of originally avian source appears to lose some of its virulence during interhuman transmission and cannot survive many passages from man to man (78, 79).

The earliest known epidemic of ornithosis occurred in Paris in 1892. A shipment of 500 parrots, 300 of which had died during voyage, had recently been imported from Brazil. There were 49 cases with 16 deaths. During the following decades only isolated cases occurred in different countries.

In the summer of 1929 an extensive pandemic set in. In the early 1930's it spread to 12 countries, causing about 800 cases of psittacosis. The source of the infection was a shipment of 5,000 parrots brought from Brazil to Buenos Aires for auction. The disease created general attention in the city when two members of a theatrical troupe died after a parrot had been used on the stage (79). The auctioned parrots and the crews of the ships carrying them transmitted the psittacosis rapidly to Europe in the latter part of 1929, at first to England (60, 62, 115), Germany (47, 54) and also to Scandinavia, i.e., Denmark (89, 133, 134) and Sweden (66). Mostly there were severe conditions among bird dealers, owners of cage birds, and hospital and laboratory personnel.

Widely known is the annual recurrence of the disease among inhabitants of the Faroe Islands in 1930—37. It is believed that arctic fulmars (*Fulmarus glacialis*) frequenting these islands had

contracted psittacosis infection by pecking dead parrots thrown overboard from transportation vessels (120). Onset of the disease always occurred in September, when the women plucked and cleaned trapped young fulmars (101). During five years 168 cases were diagnosed and were fatal in 22 per cent. One-third of the deaths were among pregnant women (121).

To restrict the occurrence of ornithosis most countries imposed a prohibition to import parrots. This had a favorable effect on the incidence of the disease during the following two decades. Thereafter the restrictions were eased in some countries with the object of better control of import of tropical birds and putting a stop to their smuggling, which had attained considerable proportions. Decision to permit import was influenced also by the widely known facts that ornithosis occurs in nearly all avian species and that antibiotic therapy is effective. Thus ornithosis again became a topical disease in the 1950's, especially as knowledge was gained of its occurrence in a form considerably milder than the dreaded psittacosis.

In the 1950's numerous reports have been published on ornithosis in all parts of Europe, including southern and eastern regions (34, 41, 51, 52, 87, 111, 114). As an example, in the Netherlands in 1950 the examination by the complement fixation test of 395 patients with pneumonia showed an ornithosis antibody titer of  $\geq 1:64$  in 9.6 per cent of patients (25). In a series of 1,251 patients with respiratory tract infection examined in England in 1952 4.2 per cent had a titer of  $\geq 1:40$ , or a significant rise in the titer (129). In Hamburg 2,814 suspected cases of ornithosis were examined in 1950-56 and a titer of  $\geq 1:64$  was obtained in 18.7 per cent of cases (130).

In the Scandinavian countries, the occurrence of ornithosis has been studied with great interest in Denmark and Norway. In Denmark 15.5 per cent of 116 patients with atypical respiratory tract infection had a titer of  $\geq 1:15$  (36). These patients served as a control series in studying the incidence of lymphogranuloma venereum. Although the viruses of lymphogranuloma venereum and ornithosis give the same group reaction in the complement fixation test, it did not occur to the investigators that the latter fact might have been the reason for these results. The first case of ornithosis in Denmark was not diagnosed until in 1953. Of 870 patients with

mainly lung symptoms 5.7 per cent showed an ornithosis antibody titer of  $\geq 1:60$  (122, 123, 124). Serums collected at random from about 5,000 patients in 1953—55 gave a titer of  $\geq 1:15$  in 7.4 per cent (76). In addition to sporadic and familial cases (11, 16, 40, 112) an epidemic in a military unit has been described in Denmark (3). According to Volkert (125), 5—10 per cent of patients with atypical pneumonia in Denmark have been found to have ornithosis.

In Norway the first case of ornithosis was diagnosed in 1955 (53). In that country special attention has been paid to the occurrence of ornithosis among children (42) and to interhuman transmission (19, 67). For example, two military epidemics have been described (31, 61). A larger series was collected in 1955—56 from Ullevål Hospital in Oslo, where 12.8 per cent of 617 patients with virus pneumonia had an ornithosis antibody titer of  $\geq 1:30$  and 3.9 per cent had confirmed acute ornithosis (71).

In Sweden one case of ornithosis was diagnosed in 1939 and four cases in 1953 (27, 39). Diseased parrots were the source of infection. In 1955, three cases were reported in the family of a dovecot owner in the province of Skåne (45). Among 114 patients with pneumonia 5.3 per cent had ornithosis (46). The State Bacteriological Laboratory of Sweden diagnosed in 1955—56 28 cases of ornithosis in various parts of the country, among others in Norrland and the island of Gotland (56).

In Finland Halonen published in 1945 three cases of Wassermann-positive lung infiltration (48). The condition may have been ornithosis.

The results obtained in tests for ornithosis antibodies in healthy persons are very interesting. In South Australia these antibodies were encountered in the titer of  $\geq 1:5$  in as many as 22 per cent of samples from a normal population of 607 persons (20). An ornithosis titer of  $\geq 1:16$  has been found in 7.2 per cent of 152 persons in the United States and a titer of  $\geq 1:15$  in 7.5 per cent of 2,186 blood donors in Norway (32, 104).

In examining the results obtained by different investigators (table 1) it is observed that those for healthy persons and for patients with respiratory infection, usually atypical pneumonia, generally are not comparable. More severe criteria are applied to the latter, while the former include also low titers. The table also

reveals that the testing technique has not been standardized. For instance, the titers reported by Danish and some Norwegian workers are three times as high as those of other investigators because they state the serum dilution after addition of the reagents.

TABLE 1  
RESULTS OBTAINED BY VARIOUS INVESTIGATORS IN STUDIES OF ORNITHOSIS ANTIBODIES

Investigator	Country	Year	Positive CF Titer ≥	Cases of Respir- atory Infection		Healthy Persons	
				No.	Positive %	No.	Positive %
Dekking & Ruys . .	Netherlands	1951	1:64	395	9.6	134	0.7
Westwood . . . . .	England	1953	1:40	1251	4.2		
Volkert & Moller Christensen . . .	Denmark	1954	1:60	870	5.7		
Mathiesen & Volkert	Denmark	1956	1:15	ca. 5000	7.4		
Weyer & Lippelt . .	Germany	1956	1:64	2844	18.7		
Lerche . . . . .	Norway	1957	1:30	617	12.8	100	14
Dane . . . . .	Australia	1955	1:5			607	22
Eng & Mackenzie . .	Norway	1957	1:15			2186	7.5
Rindge, Jungherr & Scruggs . . . . .	United States	1959	1:16			152	7.2

Ornithosis is encountered in all age groups, chiefly in persons aged 30 to 50 years but also including children of all ages, even an infant of 1 month (9). The greater proportion of patients are women, which is ascribed to their greater contact with birds. According to the literature, onset of the disease usually occurs in winter (77). Among owners of cage birds the incidence is higher in January and February, after they have received new pets as Christmas present (78). Poultry raisers are most exposed in March—May, when the number of newly hatched chicks susceptible to infection is highest (132).

The pathologic changes produced by ornithosis in man resemble mostly interstitial pneumonia (47). At autopsy the alveoli of the lungs are filled with serofibrinous fluid and red cells. The interalveolar septa are edematous and show infiltration by mononuclear cells. Numerous blood capillaries are thrombosed. In some cases there are perivascular petechiae and local necroses in the brain (10, 100). Birds, on the other hand, show fluid in the thoracic and

abdominal cavities, an enlarged liver and spleen, and possibly also necrotic foci (24).

Ornithosis has an incubation period of 7—10 days, in some cases up to 30 days. It may produce in man clinical features of three types, resembling influenza, pneumonia or typhoid fever. Contrary to earlier opinions it is now known that ornithosis frequently occurs as a subclinical condition simulating a common cold that passes within a few days. This is usually a case of interhuman infection. The term para-ornithosis has been suggested for the milder form of the disease (31). The best known type, which is also considered to be the most common, has the clinical features of atypical pneumonia. The typhoid fever type is characterized by somnolence, gastrointestinal symptoms, occasionally an enlarged spleen, and roseola. The borderline between the different types is not well delineated, for in the type resembling typhoid fever there usually are also symptoms from the lungs, and the patient with pneumonia may have diarrhea.

The onset of the disease is characterized by nausea, severe headache and chills; frequently the eyes are sensitive to light. The fever rapidly rises to 39—40° C and if not treated will persist as continua for 2—4 weeks, after which it drops lytically. Bradycardia is typical. There is usually a dry, irritating, slightly productive cough. The changes observed by percussion and auscultation are in most cases unexpectedly small in comparison to the usually clear roentgenologic changes.

The roentgenologic findings in ornithosis are in no way specific. Infiltration may be dense or fine, rarely has definite margins but is nevertheless homogeneous. Sometimes there is atelectasis. Pleural effusion is infrequent, and the process generally is limited to one portion of a lobe. Occasionally the lung findings give reason to suspect tuberculosis (3, 77), even miliary tuberculosis (2, 61), or a tumor (11, 77).

In the usual laboratory test results the erythrocyte sedimentation rate is clearly elevated but the white cell count is within normal limits or decreased. The Wassermann test has given a non-specific positive reaction in as many as 28 per cent of cases (13).

Unless treated with antibiotics, the course of typical ornithosis pneumonia is lengthy, lasting several weeks, relapses are common and recovery is slow. As complications may develop myocarditis

(9, 52, 69, 132), encephalitis (26, 64) or aseptic meningitis (42). Neurologic symptoms, such as facialis paresis (29, 51), are occasionally seen. Hepatitis (128, 136) and thyroiditis (107) have also been reported to complicate ornithosis. In pregnant women the disease may cause premature labor or abortion (116, 119).

Since ornithosis has no characteristic clinical features, diagnosis can usually be established only by virologic or serologic methods. Isolation of the virus is possible from the blood during the first days after onset or from sputum from the latter part of the first week to the third week. As a curiosity may be mentioned that the virus was found in the sputum of some patients during a number of weeks without the development of clinical symptoms (43). A biochemist was found to be a carrier 10 years after he had ornithosis (82). In cases of this kind there usually has been a predisposing factor, such as thoracoplasty or bronchiectasis. The ornithosis virus can be isolated by inoculation into the yolk sac of embryonated hen's eggs or intracerebrally into white mice. Specimens taken from the yolk sac or brain and stained by the Castaneda method show in a positive case the typical «inclusion bodies», called «L.C.L. bodies» after their discoverers Lewinthal, Coles and Lillie (18, 72, 74).

The simplest method for establishment of a diagnosis of ornithosis is demonstration of antibodies in the blood by means of the complement fixation test. Bedson (6) was the first to apply it to the diagnosis of ornithosis. Today the antigen is usually prepared by injecting ornithosis virus into the yolk sac of embryonated hen's eggs and treating the yolk sacs with phenol and boiling them. Determination of antibodies by the complement fixation test is not specific with ornithosis antigen, since also other viruses of the same group, such as those causing trachoma and lymphogranuloma venereum, give a positive reaction. These viruses have the same group antigen. Consequently antigen prepared from the virus of lymphogranuloma venereum may be used for the diagnosis of ornithosis. However, mistakes in the evaluation of the serologic test results are prevented by the completely dissimilar clinical features of lymphogranuloma venereum and trachoma as compared with ornithosis. It may also be noted that the infective agents of brucellosis and Q fever may occasionally give false positive reactions in the ornithosis complement fixation test (21, 81).

Ornithosis antibodies are not found in the patient's blood before

the eighth day after onset and the maximum titer is reached 3 to 4 weeks later. The antibody titer then declines slowly in the course of several months and somewhat elevated titers are encountered several years after the illness. Meyer (83) claims that »if the patient had been infected previously with any member of the psittacosis-lymphogranuloma group, complement-fixing antibodies against this group might be demonstrable during some other infection later. In this case the result of the first CF test may be positive, but within ten to fourteen days when a second specimen is examined they may be negative.» It is to be noted that antibiotic therapy begun early in the disease may completely inhibit or greatly retard the development of antibodies (83).

In order to determine by the complement fixation test whether or not there is a case of acute ornithosis, it is preferable to have three blood samples taken at different stages of the disease, i.e., at the onset and 2 and 4 weeks after onset. A fourfold rise in the titer is significant. Should convalescent serum only be available a titer of  $\geq 1:40$  is suspect for ornithosis (21).

The mortality rate in the classical avian-borne ornithosis pneumonia varied from 20 to 50 per cent before the antibiotic era (54). Among pregnant women in the Faroe Islands it was as high as 80 per cent (121). The prognosis is greatly influenced by the virulence of the causative agent and by the patient's general condition. Even with antibiotic therapy, deaths do still occur, although rarely. Mortality in ornithosis in West Germany in 1953—54 was 3—3.5 per cent (49). When all cases of ornithosis with a mild course are included, the mortality rate is still lower. The original psittacosis, however, is a disease of such severity that it has been pointed to as a possible weapon in microbe war in the future (73).

Tetracycline and its derivatives are generally considered to be the best in the treatment of ornithosis. The recommended dose is 1—2 gm daily. A widely accepted opinion is that penicillin has no effect on ornithosis (11, 45, 67). According to some investigators it has some effect when given in large doses (52). In the opinion of others it is the drug of choice (127). In the few cases when chloramphenicol has been used it has had a rapid therapeutic effect (17, 30, 55). It is recommended to continue medical treatment for at least ten days to prevent a relapse.

## CHAPTER II

### OBJECT OF THE PRESENT STUDY

The import of parrots is prohibited in Finland, the only exception being made in the case of Korkeasaari Zoological Gardens, Helsinki. For import of canary birds a license issued by the veterinary authorities is required (59). The occurrence of ornithosis in other species of birds is widely known, and pigeons have been found to be a source of infection in many cities in other countries. In addition, the interhuman transmission of ornithosis is being given increased attention.

Studies published in Scandinavia, especially in Denmark and Norway, show that the ornithosis virus is in these countries a very noteworthy cause of respiratory infection, especially of atypical pneumonia. This subject has not been investigated in Finland, but in view of its geographic situation close to the above it was considered possible that ornithosis may be encountered also in Finland. A serologic and clinical investigation of the occurrence of the disease in this country appeared therefore to be of interest.

Answers were sought to the following main questions:

1. Does the ornithosis virus cause pneumonia or other respiratory infections in Finland? What role does it play as an etiologic factor in cases of pneumonia in Helsinki? What are the clinical features of the condition it produces?
2. Do persons who are in close contact with birds (cage birds, domestic poultry or pigeons) have signs of a previous clinical or subclinical ornithosis infection more frequently than other persons?
3. To what extent are the pigeons in Helsinki infected with the ornithosis virus, and should they be regarded as a significant source of this infection?

## PERSONAL INVESTIGATIONS

### CHAPTER III

#### SEROLOGIC AND CLINICAL STUDIES OF PATIENTS WITH PNEUMONIA OR MILD ACUTE RESPIRATORY TRACT INFECTION

##### A. TECHNIQUE OF COMPLEMENT FIXATION TESTS

###### Reagents

*Diluent.* — As diluent was used 0.9 per cent saline solution.

*Sheep Red Cells.* — Sheep red cells were washed 3—4 times in saline solution and diluted with saline to a 2.5 per cent suspension. Cells of the same sheep were always used. Blood was drawn into a flask containing citrate solution (8 parts blood to one part citrate solution) at intervals of about two weeks and stored at +4°C (citrate = sodium citrate, 2.67; glucose, 2.2; citric acid, 0.9; distilled water to make 100 ml).

*Amboceptor.* — Serum of rabbits immunized with sheep red cells was used as amboceptor. A stock solution of 1: 100 was prepared and 5 per cent phenol was added in the ratio 0.4 ml/10 ml.

*Complement.* — A pooled guinea-pig serum drawn on the preceding day from three guinea-pigs and stored overnight at +4°C was used. Late in the winter, when a sufficiently strong complement was not always obtained from the laboratory's own guinea-pigs, a commercial complement preparation was used (Konserviertes Meerschweinchen Komplement, Behringwerke).

*Antigen.* — Ornithose Antigen manufactured by Behringwerke was used, diluted 1: 20 with saline solution.

*Control Antigen.* — The serums from cases of ornithosis which were regarded as acute were examined with control antigen manufactured by Behringwerke but not commercially available. Two ampoules of 2 ml were supplied by the manufacturer on request for this specific purpose. It was used in dilution 1: 20.

*Serums.* — Immediately after separation the serums were inactivated in a water-bath at + 56°C during 30 min. The titers of the serums dis-

appeared after inactivation was repeated a number of times. Following inactivation the serums were stored at  $+4^{\circ}\text{C}$ . For examination, the serums were diluted 1:10, 1:20 and 1:40 with saline. If antibodies were found, the serum was retested, diluting it up to 1:320.

#### Titration of Amboceptor

The amboceptor was titrated before each main test. Serial dilutions of amboceptor were prepared at 1:1,000, 1:2,000, 1:3,000, 1:4,000, 1:5,000, 1:6,000, 1:8,000, 1:10,000 and 1:12,000. Into each 0.1 ml of each amboceptor dilution were added 0.1 ml of 2.5 per cent sheep red cell suspension, 0.1 ml of complement diluted 1:15, and 0.2 ml of saline solution. The tubes were placed in a water-bath at  $+37^{\circ}\text{C}$  for 30 min. The smallest amount of amboceptor that produced complete hemolysis was selected as the amboceptor unit. Two amboceptor units were used in titration of the complement and in the main test.

#### Titration of Complement

Serial dilutions were made of the complement as follows: 1:10, 1:12.6, 1:15.8, 1:20, 1:25, 1:31.6, 1:40, 1:50 and 1:63. Into 0.1 ml of each dilution were added 0.1 ml of antigen and an equal volume of saline solution. Incubation was carried out in a water-bath at  $+37^{\circ}\text{C}$  for 15 min. The sheep red cells and the amboceptor were allowed to undergo fixation for the same length of time. Then 0.2 ml of sensitized cells were added into each tube and the tubes were placed in the water-bath at  $+37^{\circ}\text{C}$  for 30 min. The smallest amount of complement that produced complete hemolysis was selected as the unit. Two complement units were used in the main test.

#### Main Test

##### a) Direct Complement Fixation Technique

Into  $100 \times 12$  mm test tubes were pipetted 0.1 ml of each serum dilution, and the same volumes of antigen and complement in the dilutions used. The tubes were shaken and kept overnight at  $+4^{\circ}\text{C}$ . On the following morning they were placed in the water-bath at  $+37^{\circ}\text{C}$  for 15 min. The sheep red cells and the amboceptor were allowed to undergo fixation for the same length of time. Then 0.2 ml of sensitized cells were added to each tube. The tubes were incubated in the water-bath at  $+37^{\circ}\text{C}$  until the tube in the control series into which one unit of complement had been added showed moderate (++) hemolysis. This usually occurred within 10-20 min. The series was kept in the water-bath for maximum 30 min., after which it was held for 1 hr. at  $+4^{\circ}\text{C}$  and the readings were made immediately thereafter.

The results were expressed as follows:

- = no hemolysis
- += slight hemolysis
- ++ = moderate hemolysis
- +++ = nearly complete hemolysis
- ++++ = complete hemolysis

The highest serum dilution (before addition of reagents) that gave slight or no hemolysis was noted down as the titer. It corresponded to at least 75 per cent complement fixation.

*b) Indirect Complement Fixation Technique*

A number of pigeon serums were examined by the indirect complement fixation technique according to Karrer (68).

Into 0.1 ml of each serum dilution was added 0.1 ml of each of the following: 1 unit of antigen, 2 units of complement and 1 unit of a known positive serum. The tubes were kept in the water-bath at +37°C for 2 hours. The sensitized red cells were then added and incubation in the water-bath at +37°C was continued for 1 hr. The readings were made immediately.

The positive serum used was pigeon serum which previously had been examined by the direct complement fixation technique. It was titrated with different amounts of antigen (0.5, 1, 2 and 2.5 units). The positive serum unit was the smallest amount of serum which produced complete fixation of the complement with 1 unit of antigen.

As the titer of the pigeon serum was taken the highest dilution which entirely removed the antigen and thus completely inhibited the fixation of complement.

**Controls**

The controls shown in table 2 were included in each series of tests. Different amounts of complement ranging from 0.5 to 2 units were used (tubes 1—4). A hemolysis control (tube 5) and a sheep red cell control (tube 6) were also included. A known positive serum diluted in a series from 1:10 to 1:320 was used as a positive serum control. It was stored preferably in small batches at -20°C, one tube at a time being taken into use and kept in the refrigerator at +4°C. In this manner its antibody titer remained stable for several months. If the positive serum was repeatedly kept at room temperature for a number of hours the titer tended to fall and the antibodies sometimes completely disappeared. A known negative serum was included in the controls in dilutions 1:10, 1:20 and 1:40.

TABLE 2  
CONTROLS OF COMPLEMENT FIXATION TEST

Control Tube No.	NaCl 0.9 %	Antigen 1:20	Complement		Hemolytic System
			ml	Units	
1	0.17	0.1	0.025	0.5	0.2
2	0.15	0.1	0.05	1	0.2
3	0.13	0.1	0.075	1.5	0.2
4	0.1	0.1	0.1	2	0.2
5	0.2	—	0.1	2	0.2
6	0.3	—	—	—	0.2

### Effect of Different Antigens on Titration Results

Three antigens were used: Ornithose Antigen of Behringwerke, Squibb's Lygranum CF Antigen, and antigen prepared by the author. The German antigen was prepared from the ornithosis virus, the American from the lymphogranuloma venereum virus, and the author's preparation from the meningoencephalitis virus of mouse. Preliminary tests (table 3) were made to determine the dilution in which each antigen was still serviceable. The dilutions chosen for use in the experiments were 1: 20 for Behringwerke's antigen, 1: 10 for Squibb's antigen and 1: 4 for the antigen prepared by the author.

Table 4 shows the results of titrations with the three antigens. The results obtained with the antigens of Behringwerke and Squibb correspond satisfactorily. In six cases Squibb's antigen gave lower values and in two cases higher values than Behringwerke's antigen. The author's preparation gave in some cases lower titers than the other antigens. The serums were examined in two series, using the same serum dilutions with each of the antigens.

### Preparation of Author's Antigen

Antigen was prepared by the author according to the principles described by Moller Christensen (91). One ampoule of mouse meningoencephalitis virus prepared in 1948 by lyophilization of 10 per cent yolk sac suspension<sup>1</sup> was dissolved in 1 ml of sterile water and 1,000  $\gamma$  of streptomycin was added per ml of water. The suspension was injected into the yolk sac of 7-day-old chick embryos, using 0.25 ml per egg.

The eggs were candled daily. The shells of embryos living after 3 days were broken and the yolk sacs were removed and carefully rinsed in phosphate-buffered physiologic saline solution (Orion). They were ground with quartz sand in a sterile mortar containing sterile broth to form a 20 per cent suspension (2.5 ml per yolk sac weighing ca. 0.5 gm).

The yolk sac suspension was centrifuged at 1,000 r.p.m. for 5 min. To the supernatant was added 1,000  $\gamma$  of streptomycin per ml and 0.25 ml of this suspension in various dilutions was injected into 7-day-old chick embryos. The object was to find the virus dilution lethal to one-third of the embryos on the second or third day.

When this virus dilution was found, it was used for inoculation of a larger number of chick embryos. After one-third of the embryos had died on the third day all the yolk sacs were collected, keeping the yolk sacs of the dead and living embryos separate, since a better antigen is usually obtained from living embryos. The yolk sacs were carefully rinsed. A 20 per cent suspension was prepared of the yolk sacs using physiologic saline to which had been added 0.5 ml of inactivated horse serum and 0.5 mg of crystallized phenol per 100 ml. The yolk sacs were boiled in a bottle in the water-bath for 30 min.

<sup>1</sup>) Received from Kari Penttilä, M. D., State Serum Institute, Helsinki.

TABLE 3  
COMPARISON OF RESULTS OF TITRATION WITH DIFFERENT DILUTIONS OF ANTIGENS

Antigen	Serum No.						
	1420—O	423—P	264—Y	90—T	255—Y	280—Y	857—M
B 1:5	1:160	≥1:320	<1:10	1:20	1:20	1:20	1:10
B 1:10	1:160	≥1:320	<1:10	1:20	1:20	1:20	1:10
B 1:20	1:160	1:240	<1:10	1:10	1:20	1:20	1:10
B 1:30	1:80	≥1:320	<1:10	<1:10	1:10	1:20	1:10
S 1:5	1:60	1:240	<1:10	1:20	1:20	1:20	1:10
S 1:10	1:60	1:160	<1:10	1:20	1:20	1:10	<1:10
S 1:20	1:10	<1:10	<1:10	<1:10	1:10	<1:10	<1:10
O 1:2	≥1:320	1:240	<1:10	1:20	1:10	1:10	1:10
O 1:4	1:80	1:60	<1:10	1:20	1:10	<1:10	1:10
O 1:8	1:20	<1:10	<1:10	1:20	<1:10	<1:10	1:10

B = Behringwerke; S = Squibb; O = author's antigen.  
423—P = pigeon serum.

TABLE 4  
COMPARISON OF RESULTS OF TITRATION WITH DIFFERENT ANTIGENS

Serum No.	Ornithose Antigen, Behringwerke	Lygramum CF Antigen, Squibb	Author's Antigen
167—Y	1:160	1:160	1:80
184—Y	1:160	1:160	1:80
1345—O	1:120	1:80	1:40
1375—O	1:160	1:160	1:40
214—O	1:160	1:60	1:40
283—O	1:160	1:80	1:80
273—O	<1:10	<1:10	<1:10
240—Y	1:20	1:20	1:10
264—Y	<1:10	<1:10	<1:10
276—Y	<1:10	<1:10	<1:10
552—O	1:40	1:40	1:40
692—O	1:80	1:40	1:60
503—O	<1:10	<1:10	<1:10
188—Y	1:120	1:160	1:160
538—O	1:40	1:80	1:40
1172—O	1:160	1:160	1:40
1420—O	≥1:320	1:120	1:60
542—O	<1:10	<1:10	<1:10
552—P	1:160	1:20	1:40
553—P	1:120	1:160	1:40
554—P	≥1:320	≥1:320	≥1:320
568—P	≥1:320	≥1:320	≥1:320

P = pigeon serum.

The suspension was centrifuged in a Spinco centrifuge (Head No. 30) for 1 hr. and the supernatant was stored. Physiologic saline solution was added to the sediment to make a 20 per cent suspension, which was kept at + 4°C for 1 hr. Centrifugation was repeated. The supernatants obtained were used as antigen.

#### Variation in Titrations on Different Days and by Different Workers

To find out the daily variations in the titration results 10 serums were examined on two successive days (table 5), using the complement obtained from the laboratory guinea-pigs. New serum dilutions were made on the second day.

Titration results obtained by three persons of the laboratory staff, listed in table 5, show that no variations exceeding one tube occurred between the different workers and on different days.

TABLE 5  
VARIATION OF TITRATION RESULTS ON DIFFERENT DAYS AND BY DIFFERENT LABORATORY WORKERS

Serum No.	Date and Worker					
	April 7, 1960			April 8, 1960		
	V.P.	S.T.	E.J.	V.P.	S.T.	E.J.
167—Y	1:160	1:160	1:160	1:160	1:160	1:160
184—Y	1:160	1:120	1:160	1:80	1:120	1:160
1345—O	1:160	1:80	1:80	1:60	1:60	1:160
1375—O	1:80	1:80	1:80	1:80	1:80	1:160
214—O	1:160	1:80	1:80	1:60	1:80	1:80
283—O	1:160	1:80	1:80	1:80	1:80	1:160
273—Y	<1:10	<1:10	<1:10	<1:10	<1:10	<1:10
240—Y	1:15	1:20	1:20	1:10	1:10	1:20
264—Y	<1:10	<1:10	<1:10	<1:10	<1:10	<1:10
276—Y	<1:10	<1:10	<1:10	<1:10	<1:10	<1:10

#### Q Fever Complement Fixation Test

Behringwerke's Q Fieber Antigen, diluted 1: 20, was used in the Q fever complement fixation test. A non-specific antigen was not available.

The serums under examination were diluted and the test was performed by the method used in the ornithosis antibody examination.

#### Adenovirus Complement Fixation Test

The adenovirus antigen and the non-specific antigen for this test were prepared in HeLa cells by the method used in this laboratory (93). Two batches of antigen were exceptionally prepared in amnion cells. Adenovirus type 2 (strain Huebner) was used. The different batches of antigen were used in dilutions 1:4 or 1:8.

The serums under examination were diluted 1:4, 1:16, 1:64 and 1:256. The complement fixation test was carried out by the method used in the ornithosis antibody examination.

#### B. ORNITHOSIS ANTIBODIES IN PATIENTS WITH PNEUMONIA OR MILD ACUTE RESPIRATORY TRACT INFECTION

##### MATERIAL

Collection of the series of patients for this investigation was begun in Helsinki in early October 1958 and completed about the middle of March 1960. The specimens were obtained from the Aurora Hospital (up to 1952 the Helsinki Epidemic Hospital) to which are admitted the greater part of the adult and child patients with pneumonia in Helsinki needing hospital treatment. The hospital physicians and nurses were informed of the projected investigation in staff meetings and personally. On October 8, 1958 written instructions for the taking of samples were given to all wards in the hospital's epidemic and medical departments for adults and children. Only a few sporadic samples were received from other hospitals in Helsinki.

From other regions of Finland samples were received from February 1959 to March 1960. To obtain them, 165 personal letters were sent to 40 physicians of 14 hospitals situated in 13 localities in various parts of Finland. Despite repeated requests, no samples were obtained from tuberculosis sanatoriums or tuberculosis district offices.

It was requested that paired serums be sent of patients with pneumonia and also of patients visiting the outpatient clinics because of mild acute respiratory illnesses. The following manner of taking the samples was recommended: Sample I on admission of the patient for treatment, sample II two weeks later, and sample III

four weeks after the first sample. If the serum of a patient in Helsinki was found to have a high ornithosis antibody titer ( $\geq 1: 40$ ), the laboratory wrote him personally, requesting him to come to the hospital to give one more sample (III or IV). Elsewhere in Finland the request for further samples was sent to the local hospital in connection with forwarding of the test results.

The hospital's diagnosis of each patient was controlled from the hospital record and in some rare cases from the card file of the outpatient clinic. Series 1 included the patients with a clinical diagnosis of pneumonia, bronchopneumonia or pleuropneumonia. Patients with acute bronchitis or acute infection (respiratory) were placed in series 2. A diagnosis of atypical pneumonia or virus pneumonia was rarely encountered. Series 1 consisted of 758 patients and series 2 of 236 patients, totaling 994 patients. The greater portion of the second series were cases in which pneumonia was suspected on admission but was cancelled on closer examination. From the series were excluded 125 patients whose final diagnosis did not come under the above two categories, and 4 patients whose serums were anticomplementary.

From Helsinki 731 paired serums were obtained. With 9 exceptions they were from the Aurora Hospital and included 13 paired serums from the hospital's outpatient clinic. From other regions of Finland 263 paired serums were received from six hospitals, as follows: Pyynikki Hospital, Tampere, 62; South Saimaa Central Hospital, Lappeenranta, 38; Savonlinna Central Hospital, Savonlinna, 20; Middle Finland Central Hospital, Jyväskylä 18; Vaasa Central Hospital, Vaasa, 17; Lapland Children's Hospital, Rovaniemi, 108 paired serums (fig. 1).

Two blood samples at an interval of two weeks were obtained from the greater portion of the series, 741 patients (74 per cent). Three or more samples were drawn from 257 patients (26 per cent), consisting of 230 patients in Helsinki (31 per cent) and 27 patients elsewhere in Finland (10 per cent).

## RESULTS

### 1. PATIENTS WITH PNEUMONIA

Of the 758 patients with pneumonia, 546 (72 per cent) were from Helsinki and 212 (28 per cent) from other regions of Finland. During the period that the present investigation was being made, 921



Fig. 1. — Distribution of blood samples from regions outside Helsinki according to location of hospital where taken  
 x = Case of ornithosis

patients were treated in the Aurora Hospital with pneumonia (bronchopneumonia, pleuropneumonia) as the first diagnosis in the hospital record. From 539 of these patients (59 per cent) paired serums were obtained for the ornithosis antibody studies; these were 274 children (48 per cent of all children treated for pneumonia) and 265 adults (76 per cent). Fig. 2 shows the monthly distribution of the cases treated in the Aurora Hospital.

The distribution of the patients by age is shown in fig. 3 and table 6. The largest age group (28 per cent) was comprised of children aged 1—5 years. All together 55 per cent of the patients were under 16 years of age. The largest number of adult patients with pneumonia were in the age group of 41—60 years, which consisted of 20 per cent of the total series of patients with pneumonia. The youngest patient was aged 1 month and the oldest 81 years.

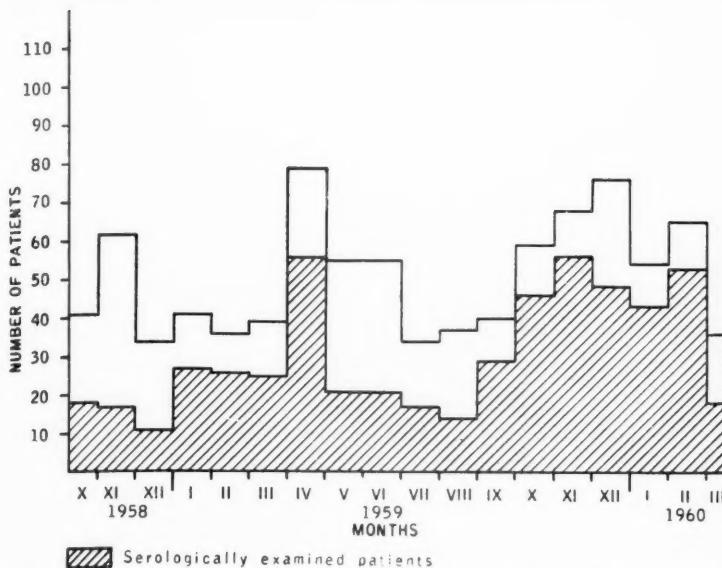


Fig. 2. — Monthly distribution of patients with pneumonia admitted to the Aurora Hospital in course of the present investigation

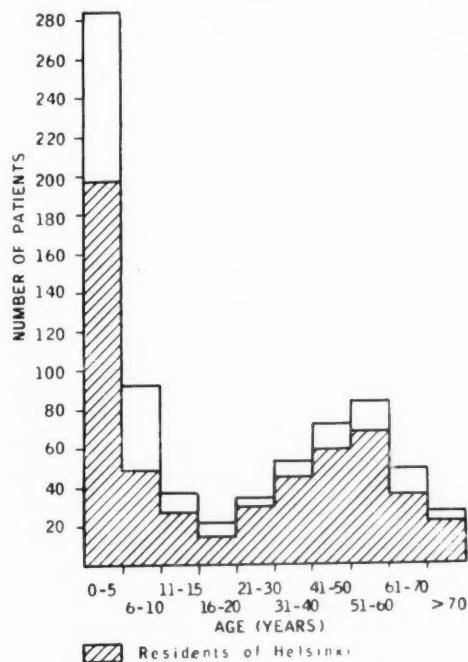


Fig. 3. — Age distribution of patients with pneumonia

TABLE 6  
AGE DISTRIBUTION OF PATIENTS WITH PNEUMONIA

Age, yrs.	< 1	1-5	6-10	11-15	16-20	21-30	31-40	41-50	51-60	61-70	>70	Total
Patients:												
Number	72	213	93	38	22	35	53	72	84	49	27	758
Per cent	9	28	13	5	3	5	7	9	11	6	4	100

TABLE 7  
MONTHLY DISTRIBUTION OF ONSET OF PNEUMONIA

Year Month	1959												1960			Total
	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II				
Patients:																
Number	53	88	45	44	23	17	38	55	68	67	62	71	631			
Per cent	8	14	7	7	4	3	6	8	11	11	10	11	100			

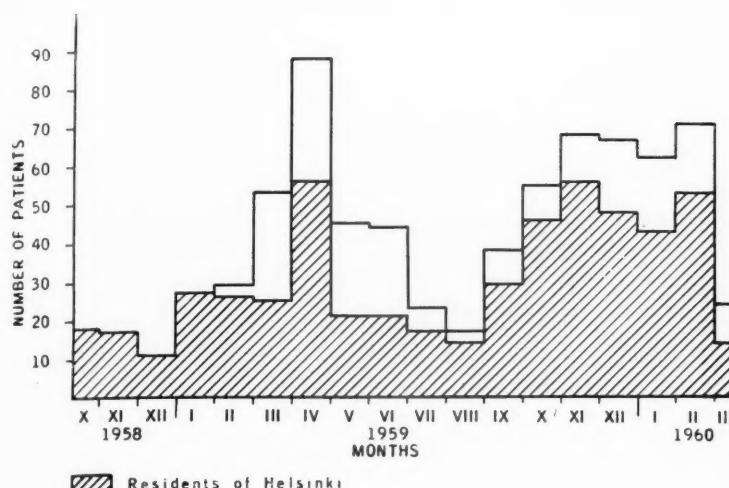


Fig. 4. — Serologically examined patients with pneumonia distributed by month of onset

There were 331 female patients (44 per cent) and 427 male patients (56 per cent).

The distribution by month of onset of the pneumonia is given in fig. 4 and table 7. For practical reasons this is the month when the first sample of serum was taken. In examining the data in fig. 4, consideration should be given to the fact that it took several months before sending of the samples from the wards became a routine procedure. In addition, the first requests for serums were sent to other hospitals in February 1959, when a general survey of ornithosis was published in *»Suomen Lääkärilehti»* (65). Table 7 is a monthly distribution of the present series of cases of pneumonia in Helsinki and other parts of the country during the 12 month period of March 1959—February 1960 when samples were received from various regions. Onset was most common during the winter months. April showed the largest number of cases.

In order to save the expensive antigen, all second and third sera were first studied. If a titer of  $\geq 1: 10$  was found, parallel tests were made of serums I and II. This principle was adopted after experimentation for some months. In table 8 the patients with pneumonia are distributed according to the ornithosis antibody titer in the second serum: 13.5 per cent of patients had a titer of  $\geq 1: 10$

TABLE 8  
PATIENTS WITH PNEUMONIA FROM HELSINKI AND FROM OTHER LOCALITIES, DISTRIBUTED BY ORNITHOSIS ANTIBODY TITER

Ornithosis CF Titer of 2nd Serum	<1:10	1:10	1:15	1:20	1:30	1:40	1:60	1:80	1:120	≥1:160	≥1:10	≥1:20	≥1:40
Patients:													
Helsinki 546 . . . . .	466	13	12	17	8	9	6	6	2	7	14.7	10.1	5.5
Other localities 212 . . . . .	190	4	3	7	4	—	—	2	—	2	10.4	7.1	1.9
Total 758 . . . . .	656	17	15	24	12	9	6	8	2	9	13.5	9.2	4.5

TABLE 9  
CORRELATION OF ORNITHOSIS ANTIBODY TITER ≥1:10 WITH AGE OF PATIENTS WITH PNEUMONIA

Age, yrs.	<1	1—5	6—10	11—15	16—20	21—30	31—40	41—50	51—60	61—70	>70	Total
All patients . . . . .	72	213	93	38	22	35	53	72	84	49	27	758
Patients with titer ≥1:10:												
Number . . . . .	14	16	8	6	4	13	14	19	5	3	102	
Per cent of age group . . . . .	—	7	17	21	27	11	25	19	23	10	11	13

and 9.2 per cent had a titer of  $\geq 1: 20$ . No significant difference in the incidence of titers 1: 10—1: 30 was seen between Helsinki and other regions of Finland ( $P > 5$  per cent). A titer of  $\geq 1: 40$  was encountered in 5.5 per cent of the patients from Helsinki and in 1.9 per cent of other patients, the difference being significant ( $P 0.6$  per cent).

The solid line in fig. 5 presents the distribution of the patients with pneumonia and mild acute respiratory tract infection by the ornithosis antibody titer in serum II. Two peaks are clearly seen in this curve. The dotted line represents the blood donors grouped in

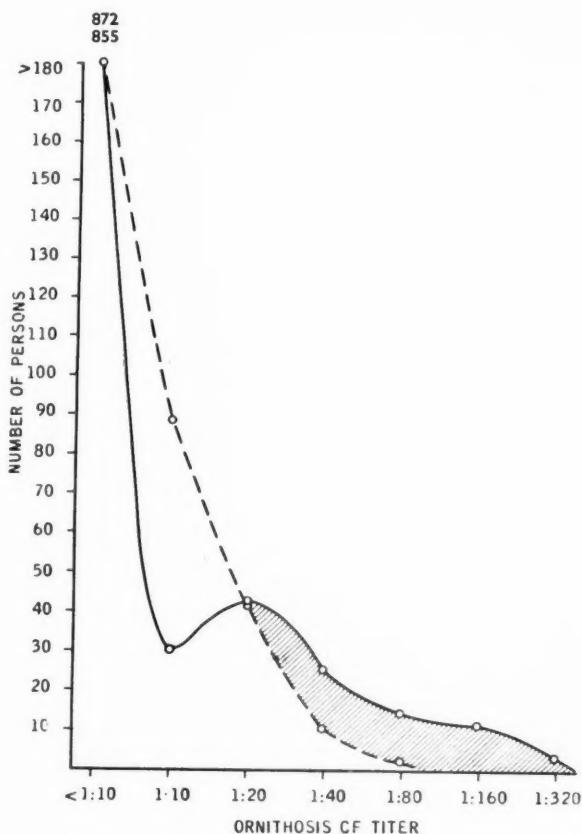


Fig. 5. — Ornithosis antibody titers in patients with pneumonia and mild acute respiratory tract infection and in blood donors

— = Patients  
— = Blood donors

Intermediate titers added alternately to the higher and the lower titer

the same manner (Chapter IV/4). The shaded area between the two curves represents the majority of patients suffering from acute ornithosis. The greater number of titers 1: 10 among blood donors probably is due to the fact that 58 per cent of the patients with respiratory infections were children. Fig. 6 gives the distribution of the ornithosis antibody titers in patients with pneumonia and mild acute respiratory tract infection in Helsinki and the other regions of Finland studied.

On comparison of the incidence of ornithosis antibodies in the different age groups (table 9) it seems probable that infants generally do not have these antibodies. In aged persons their relatively low incidence is probably due to the frequent occurrence of non-infectious pneumonia in this age group. In other respects there appeared to be no difference in the presence of ornithosis antibodies in the different age groups.

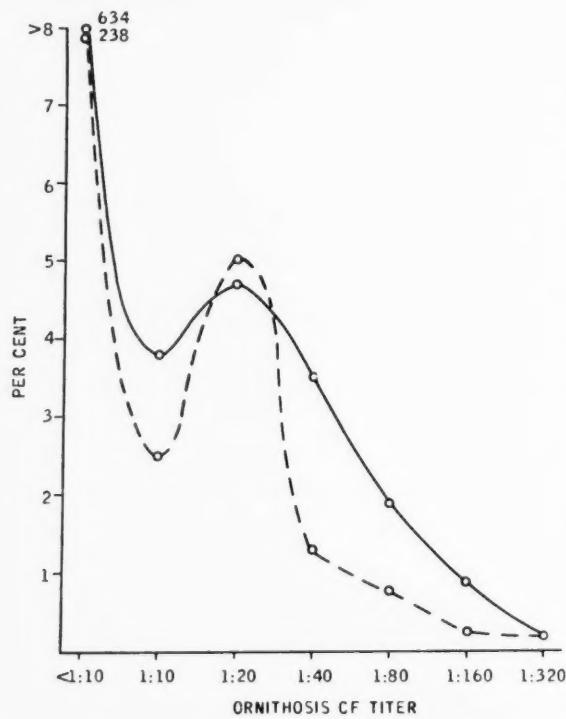


Fig. 6. — Ornithosis antibody titers in patients with pneumonia and with mild acute respiratory tract infection from Helsinki and elsewhere in Finland

— = Patients from Helsinki  
 - - = Patients from other regions

TABLE 10  
MONTHLY DISTRIBUTION OF ONSET OF MILD ACUTE RESPIRATORY TRACT INFECTION

Year Month	III	IV	V	VI	VII	VIII	IX	X	XI	XII	1960 I	II	Total
Patients:													
Number . . . . .	19	24	14	11	7	10	32	26	17	16	19	20	215
Per cent . . . . .	9	11	7	5	3	5	15	12	8	7	9	9	100

TABLE 11  
PATIENTS WITH MILD ACUTE RESPIRATORY TRACT INFECTION FROM HELSINKI AND FROM OTHER LOCALITIES, DISTRIBUTED BY  
ORNITHOSIS ANTIBODY TITER

Ornithosis CF Titer of 2nd Serum	<1:10	1:10	1:15	1:20	1:30	1:40	1:60	1:80	≥ 1:10 %	≥ 1:20 %	≥ 1:40 %
Patients:											
Helsinki 185 . . . . .	168	5	—	2	2	5	1	2	9.2	6.5	4.3
Other localities 51 . . . . .	48	—	1	1	—	1	—	—	5.9	3.9	2.0
Total 236 . . . . .	216	5	1	3	2	6	1	2	8.5	5.9	3.8

## 2. PATIENTS WITH MILD ACUTE RESPIRATORY TRACT INFECTION

The series of 236 patients with mild acute respiratory tract infection included 185 patients (78 per cent) from Helsinki and 51 patients (22 per cent) from other regions of Finland. With two exceptions the paired serums from patients in Helsinki were obtained in the Aurora Hospital. The hospital's outpatient clinic supplied 11 samples.

There were 104 female patients (44 per cent) and 132 male patients (56 per cent).

Children numbered 167 (71 per cent) and adults 69 (29 per cent). The largest age group was composed of children aged 1—5 years and totaled 74, or 31 per cent of the series of patients with mild acute respiratory tract infection (table 12).

Table 10 shows the patients with mild acute respiratory infection distributed according to the month of onset during the 12 months from March 1959 to February 1960 when samples were received from Helsinki and other regions. In most cases the onset of the disease occurred between September and April.

The second serum of the patients with mild acute respiratory infection had an ornithosis antibody titer of  $\geq 1: 10$  in 8.5 per cent of cases and a titer of  $\geq 1: 20$  in 5.9 per cent (table 11). No marked difference was observed in the incidence of titers 1: 10—1: 30 in Helsinki and in other regions ( $P > 5$  per cent). Titer  $\geq 1: 40$  was encountered in 8 patients from Helsinki and one patient from other regions; the difference was not significant ( $P > 5$  per cent).

Correlation of the ornithosis antibody titer to the patient's age in the mild acute respiratory infection series (table 12) revealed a similar situation as in the pneumonia series.

On comparison of high titers of ornithosis antibodies in the pneumonia and mild acute respiratory infection series no significant difference was observed between the two series ( $P > 5$  per cent).

## 3. ACUTE ORNITHOSIS

### CRITERIA

As acute ornithosis were classified the cases in which the serologic results of two or more serum samples filled one or more of the following main criteria:

1) Definite rise in the ornithosis antibody titer during the present illness to a high level, followed by a fall;

TABLE 12  
CORRELATION OF ORNITHOSIS ANTIBODY TITER  $\geq 1:10$  WITH AGE OF PATIENTS WITH MILD ACUTE RESPIRATORY TRACT INFECTION

Age, yrs.	<1	1-5	6-10	11-15	16-20	21-30	31-40	41-50	51-60	61-70	>70	Total
All patients . . . . .	37	74	34	22	5	11	7	7	18	11	10	236
Patients with titer $\geq 1:10$ :												
Number . . . . .	1	3	3	1	1	2	2	2	3	1	3	20
Per cent of age group..	—	1	9	14	20	9	29	29	17	9	30	—

2) A fourfold or greater rise in the antibody titer during the acute phase, or an at least fourfold drop in titer during recovery;

3) An ornithosis antibody titer of such a high level that it was considered to have been caused by the acute disease. Titer 1: 60 was selected as the borderline. The literature considers in general that a titer of  $\geq 1: 40$  is very suspect for ornithosis. In view of the nature of the present investigation it was regarded that a stricter basis than usually used was necessary.

A further condition for inclusion in the acute ornithosis group was a negative reaction in the examination of the patient's serum with control antigen.

For the sake of brevity the cases of ornithosis classified as acute will be termed merely ornithosis in this report.

#### CASE SERIES

A total of 43 cases of ornithosis were found in the course of the present investigation. They were grouped as follows according to the above criteria: Group 1, 13 cases; group 2, 22 cases; group 3, 8 cases. On basis of the clinical diagnosis they were grouped as follows: Pneumonia (broncho-, pleuro-), 35 cases; pulmonary infiltration, 1 case; acute bronchitis, 2 cases; acute infection (respiratory), 5 cases.

There were 38 patients from Helsinki; 35 of them were patients in the Aurora Hospital and 1 was an employee in the hospital's laboratory. Two patients were treated in the Kivelä Hospital.

In addition, 5 cases of ornithosis were diagnosed among patients in different regions of Finland.

#### FOLLOW-UP EXAMINATIONS

The patients in Helsinki who had ornithosis were called to a follow-up examination. This took place 3—17 months after onset, averaging 9 months from onset. Of the 38 patients from Helsinki, 32 arrived for examination. Two of those who could not be contacted had moved to another locality and one patient had died of another disease.

In a personal conversation with the patient further information was obtained on the symptoms and course of the disease. Points of epidemiologic significance were also discussed. In the same connection a new blood sample was taken for determination of ornithosis antibodies.

#### EPIDEMIOLOGY

The five cases of ornithosis in various regions of Finland were grouped according to locality as follows: 1 case from Tampere, 2 cases from vicinity of Lappeenranta (Joutseno and Lemi), 1 case from Vaasa, and 1 case from Sodankylä (fig. 1).

The Helsinki patients were from nearly all districts of the city: Central district, 3; Kruununhaka, 3; Eira, 3; Töölö, 8; Munkkiniemi, 2; Haaga, 1; Lauttasaari, 2; Kallio, 4; Käpylä, 3; Maunula, 2; Oulunkylä, 1; Malmi, 1; Vartiokylä, 4.

Information on possible contact with birds was obtained from 36 patients. Of these, 14 (39 per cent) stated they had had close contact with birds, i.e., 13 with pigeons and 1 with domestic poultry.

Twenty-nine patients with ornithosis were questioned concerning cases of illness in their environment. Similar symptoms in persons in their own family or at their place of work were reported by 13 (45 per cent) of these patients. In 7 cases none of the infected family members had been known to have had contact with birds.

#### AGE AND SEX OF PATIENTS

The ornithosis series consisted of 18 children (42 per cent of group) and 25 adults (58 per cent). The largest age group were children aged 6—10 years, who numbered 9, or 21 per cent of the group (table 13). The youngest patient was 2 years 4 months old and the oldest 82 years of age.

There were 23 female patients (53 per cent) and 20 male patients (47 per cent).

#### MONTH OF ONSET

Table 14 shows the distribution of the patients according to the month of onset stated in the hospital report. These reports were available for 42 patients. Most of the cases occurred in September and April. The ornithosis virus appeared to give rise to disease more commonly in the late summer than in midwinter.

#### CLINICAL SYMPTOMS

Data on the subjective symptoms of 42 patients were based on their own statements on admission to hospital and at the follow-up examination. It may well be understood that description of the

TABLE 13  
AGE DISTRIBUTION OF PATIENTS WITH ORNITHOSIS

Age, yrs.	1—5	6—10	11—15	16—20	21—30	31—40	41—50	51—60	61—70	70	Total
<b>Ornithosis:</b>											
Number .....	6	9	3	3	7	4	7	7	—	1	43
Per cent .....	14	21	7	7	16	10	16	16	—	2	100
<b>All respiratory infections:</b>											
Number .....	287	127	60	27	46	60	79	102	60	37	885
Ornithosis, per cent ..	2	7	5	11	7	12	5	7	—	3	

TABLE 14  
MONTHLY DISTRIBUTION OF ONSET OF ORNITHOSIS

Year	Month	III	IV	V	VI	VII	VIII	IX	X	XI	XII	1960	I	II	Total
<b>Ornithosis:</b>															
Number .....	3	6	—	3	2	2	8	3	3	2	1	1	1	1	34
Per cent .....	9	17	—	9	6	6	23	9	9	6	3	3	3	3	100
<b>All respiratory infections:</b>															
Number .....	72	112	59	55	30	27	70	81	85	83	81	91	91	91	846
Ornithosis, per cent .....	4	5	—	5	7	7	11	4	4	2	1	1	1	1	

symptoms was in many cases influenced by the character of the patient. The milder symptoms are readily forgotten. It is also to be held in mind that many of the patients were children, whose case history was given by the mother. The figures for symptoms given below should therefore probably be regarded as minimum values.

TABLE 15  
DISTRIBUTION OF 42 PATIENTS WITH ORNITHOSIS BY SUBJECTIVE SYMPTOMS

Symptoms	No. of Patients	Per cent
Cough . . . . .	40	95
Coryza . . . . .	24	57
Chest pain . . . . .	15	36
Vomiting . . . . .	14	33
Headache . . . . .	10	24
Painful limbs . . . . .	5	12
Epistaxis . . . . .	4	10
Sore throat . . . . .	4	10
Hoarseness . . . . .	4	10
Sensitivity of eyes to light . . . . .	4	10

Cough was the most common symptom and was complained of by 40 patients. Two patients had no cough (table 15). In 21 cases it was severe, often disturbing sleep, and cough medicines infrequently gave relief (table 16). In 19 cases there was a dry cough; thus one-half of the patients had a hard, dry cough. Fifteen patients stated that cough had been their first symptom. In only 4 cases it had appeared later than 3 days after onset of the disease.

TABLE 16  
PATIENTS WITH ORNITHOSIS DISTRIBUTED BY QUALITY AND DURATION OF COUGH

Quality of Cough	No. of Patients	Per cent	Duration of Cough	No. of Patients	Per cent
No cough . . . . .	2	5	—	—	—
Slight . . . . .	7	17	Under 2 weeks	9	23
Moderate . . . . .	9	21	2—4 »	17	42
Severe . . . . .	24	57	Over 4 »	14	35
Total . . . . .	42	100	Total	40	100

Coryza was present in 24 cases. Usually it was not inconveniencing. Sinuitis developed as a complication in only 4 cases. Four patients had had nosebleed early in the disease. Four had had a sore throat and as many had experienced hoarseness.

Headache was complained of by 10 patients. There had been pain in the limbs in 5 cases. Four patients had observed sensitivity of the eyes to light. It is to be observed that children seldom complain of or are able to observe symptoms of these kinds. Even adults sometimes pay no attention to sensitivity of the eyes or to a mild extremity pain.

Vomiting was reported by 14 patients. In children it is a common symptom of disease, but a more noteworthy fact was that 5 adults had vomited.

Pain in the chest was felt by 15 patients. Evidently it is a rather frequent symptom in ornithosis.

The body temperature rose suddenly in 22 cases and gradually in 20 cases. Temperatures over  $39^{\circ}\text{C}$  were recorded in 28 cases (table 17), while in 4 cases only a slight rise occurred.

TABLE 17

PATIENTS WITH ORNITHOSIS DISTRIBUTED BY DEGREE AND DURATION OF FEVER

Degree	No. of Patients	Per cent	Duration of Fever ( $\geq 37.5^{\circ}\text{C}$ )	No. of Patients	Per cent
$37.5^{\circ}\text{C}$ — $37.9^{\circ}\text{C}$	4	10	Under 2 weeks	29	69
$38.0^{\circ}\text{C}$ — $38.9^{\circ}\text{C}$	10	24	2—4 "	11	26
Over $39^{\circ}\text{C}$	28	66	Over 4 "	2	5
Total	42	100	Total	42	100

On admission 11 patients were afebrile (temperature below  $37.5^{\circ}\text{C}$ ). It should be noted that the rectal temperature was measured in the case of children up to the age of 15.

The condition of 8 patients was serious on admission to the hospital. It is to be held in mind in this connection that the hospitalized cases usually are those of greatest severity and longest duration.

Percutory or auscultative changes in the lungs were observed on the day of admission in 32 patients. In the ward a relative bradycardia (pulse rate below 105/min.) was observed in 8 (62 per cent) of the 13 patients with high fever (temperature over  $38.5^{\circ}\text{C}$ ).

## ROENTGENOLOGIC FINDINGS

The following summary of the roentgenologic findings in the lungs of the patients with ornithosis pneumonia is based on the report of the roentgenologist concerning the chest x-rays of 29 patients treated in the Aurora Hospital. A more detailed roentgenologic analysis will be published in another connection (109). The distribution of the findings has been made on the basis of the localization, shape and size of the changes, uni- or multifocality, atelectasis, signs of pleural effusion, and hyperplasia of hilar lymph nodes.

In 10 cases the changes were localized in the right lung and in 12 cases in the left lung. Bilateral changes were encountered in 7 patients.

A classification according to type of pneumonia is as follows: Atypical pneumonia, 14 cases; bronchopneumonia, 13 cases; seg-

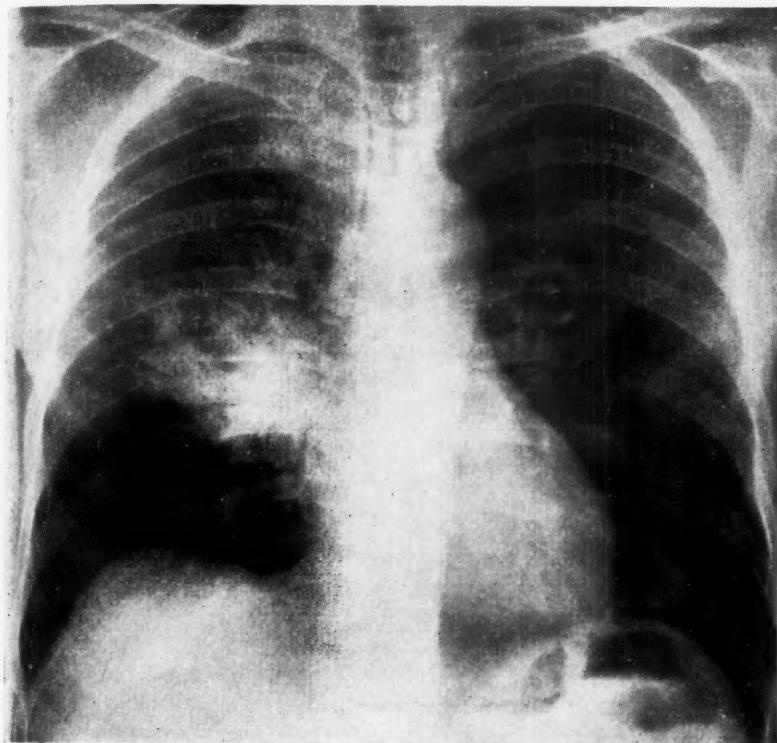


Fig. 7. — Chest x-ray in case 13 on Jan. 18, 1960

mental pneumonia, 2 cases. Atelectasis was present in 10 cases (34 per cent), signs of pleural effusion in 16 cases (55 per cent), and hilar hyperplasia in 19 cases (66 per cent). In one case a cavity-like formation was seen (case 12).

For a long time, tumor was suspected in 1 case (case 12), and in 4 cases the roentgenologic finding seemed at first to suggest tuberculosis (cases 20, 29, 32 and 34).

#### RESULTS OF LABORATORY TESTS

The erythrocyte sedimentation rate (ESR) attained fairly high values in many patients, especially if they had been ill at home for some length of time without adequate treatment with antibiotics. Values over 80 mm/1 hr. were seen in 10 cases, in 4 of which it was over 100 mm/1 hr. (table 18). In 7 cases it was below 20 mm/1 hr. The latter patients were already recovering at the time of admission.

The white cell count was done in 40 cases on admission. These patients were distributed according to the first blood cell count made in the hospital (table 18). The white cell count in 14 patients was less than 6,000, the lowest value being 2,900. In 70 per cent of cases it was normal or slightly reduced ( $\leq$  9,000). In 6 patients there were over 12,000 white cells. Three patients in the latter group were children under 10 years of age; 1 patient had also pyelitis, and 1 patient suffered from violent vomiting.

TABLE 18  
PATIENTS WITH ORNITHOSIS DISTRIBUTED BY ESR AND WHITE CELL COUNT

ESR, mm/hr	No. of Patients	Per cent	White Cell Count	No. of Patients	Children under 10 yrs.	Per cent
Under 20	7	17	Under 6,000	14	3	35
20—50	12	28	6,000—9,000	14	3	35
51—80	13	31	9,000—12,000	6	3	15
Over 80	10	24	Over 12,000	6	3	15
Total	42	100	Total	40	12	100

The general observation may be made that leukocytosis does not usually appear in ornithosis. In the acute phase of the disease the white cell count in most cases was normal or slightly reduced, whereas the erythrocyte sedimentation rate was high in this phase.

The example may be cited of a patient (case 16) whose ESR on admission was 111 and the white cell count 3,800.

The white cell differential count was carried out in 34 cases. The results show that there were less than 25 per cent lymphocytes in 20 patients (59 per cent) and over 25 per cent in 14 patients. In the acute stage the relative number of lymphocytes tended to fall, rising again during recovery. The monocyte count was less than 5 per cent in 15 patients and over 5 per cent in 19 cases. Eosinophilia was not found. A shift to the left in the differential white cell count, with over 6 per cent staff cells, was seen in 9 patients (26 per cent) in the early stage of the disease.

#### DURATION OF DISEASE

The duration of fever was less than 2 weeks in 29 patients (table 17). In only 2 cases it persisted for over 4 weeks and toward the end of this period there was a slight rise in temperature and not a high fever.

On the other hand, cough was more lengthy, 31 patients coughing for over 2 weeks and 14 for over 4 weeks (table 16). In some cases the cough persisted for 2-3 months.

The roentgenologic lung changes also were generally of long duration. Since the first roentgenograms had been taken at very different stages in the various cases, the length of time from onset of the disease to disappearance of the roentgenologic changes was recorded. In 6 cases this required over 9 weeks, and in 11 patients 6-9 weeks (table 19). Thus the changes persisted for over 6 weeks in about one-half of the patients.

TABLE 19  
PATIENTS WITH ORNITHOSIS DISTRIBUTED BY DURATION OF ROENTGENOLOGIC CHANGES AND OF DISEASE

Duration of Roentgenologic Changes	No. of Patients	Per cent	Duration of Disease	No. of Patients	Per cent
Under 3 weeks	3	9	Under 3 weeks	6	14
3-6 "	15	43	3-6 "	23	55
6-9 "	11	31	6-9 "	7	17
Over 9 "	6	17	Over 9 "	6	14
Total	35	100	Total	42	100

Duration of disease was regarded to be the duration of the acute stage of the disease, i.e., length of illness at home before admission + length of hospitalization. In this connection it must be taken into consideration that owing to shortage of beds the patients usually are discharged from hospital quite soon after recovery has begun. The duration of the illness naturally coincides fairly well with the duration of the roentgenologic changes (table 19). Six patients were ill for over 9 weeks. The longest durations of disease were 3 months and 4 months. Even these patients were ambulant for a considerable part of this time.

The average length of hospitalization for 41 patients with ornithosis was 20 days. The shortest treatment period was 7 days and the longest 11 weeks. Since the cost of hospitalization in the Aurora Hospital is at the present time Finnmarks 5,600 per patient per day (57), of which the patient pays Finnmarks 600, the cost to the community of the hospital treatment of each patient with ornithosis is, on the average, Finnmarks 100,000.

The sick leave of 20 patients in Helsinki who were working averaged 1½ months.

#### RELAPSES AND COMPLICATIONS

Relapse occurred in 4 patients (cases 4, 20, 23 and 34).

In two patients the disease was complicated by aseptic meningitis (cases 19 and 24). The diagnosis of ornithosis was confirmed further by the familial history in the former case and a positive Wassermann reaction in the second serum in the latter case. A possibility that two virus infections were present at the same time cannot, of course, be wholly excluded.

In four cases the disease was complicated by sinuitis. No other concurrent diseases than the above mentioned were found.

No deaths occurred due to ornithosis.

#### ORNITHOSIS ANTIBODY TITERS

Table 20 shows the ornithosis antibody titers of the patients' serum samples, the date of each sample being calculated from the date of onset reported by the patient. On examining the appearance of antibodies into the blood of the 24 patients from whom the first blood sample was obtained during the first two weeks after

TABLE 20

RESULTS OF ORNITHOSIS COMPLEMENT FIXATION TESTS IN PATIENTS WITH ACUTE ORNITHOSIS

Case No.	Age, yrs.	Diagnosis	Serum No.	Period after Onset	Ornithosis CF Titer
1	17	Pneumonia l. dx.	I	7 days	1:40
			II	20 "	1:80
			III	4 1/2 months	1:30
			IV	17 "	1:10
2	10	Pneumonia l. sin.	I	10 days	1:80
			II	20 "	1:320
			III	2 1/2 months	1:120
			IV	16 1/2 "	1:10
3	49	Pneumonia l. dx.	I	2 days	1:5
			II	24 "	1:30
			III	1 1/2 months	1:120
			IV	2 "	1:80
			V	12 "	1:15
4	9	Bronchopneumonia	I	ca. 10 days	1:5
			II	3 months	1:320
			III	3 1/2 "	1:160
			IV	4 "	1:30
			V	4 1/2 "	1:20
5	3	Bronchopneumonia l. a.	I	1 month	1:15
			II	1 1/2 "	1:60
			III	2 "	1:60
			IV	2 1/2 "	1:30
			V	13 "	1:30
6	56	Pneumonia l. sin.	I	5 days	1:30
			II	17 "	1:60
			III	1 1/2 months	1:60
			IV	11 1/2 "	1:10
7	3	Bronchopneumonia l. a.	I	10 days	1:15
			II	19 "	1:60
			III	2 1/2 months	1:15
8	39	Pneumonia l. dx.	I	8 days	1:20
			II	20 "	1:160
			III	2 months	1:20
			IV	5 1/2 "	1:20

Case No.	Age, yrs.	Diagnosis	Serum No.	Period after Onset	Ornithosis CF Titer
9	51	Pneumonia l. sin.	I	ca. 1 month	1:80
			II	2 months	1:120
			III	6 "	1:40
10	60	Bronchopneumonia l. dx.	I	ca. 1/2 month	1:40
			II	1 "	1:80
			III	2 months	1:30
11	4	Pneumonia l. dx.	I	7 days	<1:10
			II	21 "	1:80
			III	2 1/2 months	1:20
12	52	Pneumonia l. dx.	I	3 days	1:5
			II	25 "	1:80
			III	1 1/2 months	1:120
			IV	2 "	1:120
			V	2 1/2 "	1:60
			VI	3 1/2 "	1:60
			VII	5 "	1:40
13	49	Pneumonia l. dx.	I	18 days	1:30
			II	30 "	1:80
			III	1 1/2 months	1:40
			IV	2 1/2 "	1:40
14	48	Pneumonia l. a.	I	15 days	1:20
			II	25 "	1:40
			III	1 1/2 months	1:30
			IV	15 "	1:10
15	35	Pneumonia l. dx.	I	11 days	1:40
			II	21 "	1:30
			III	1 month	1:20
			IV	14 1/2 months	1:10
16	44	Pneumonia l. a.	I	ca. 1 month	1:120
			II	1 1/2 months	1:160
			III	13 1/2 "	<1:10
17	55	Bronchopneumonia l. sin.	I	ca. 1 month	1:120
			II	1 1/2 months	1:120
			III	2 "	1:60
			IV	13 "	<1:10

Ornithosis CF Titer	Case No.	Age, yrs.	Diagnosis	Serum No.	Period after Onset	Ornithosis CF Titer
1:80 1:120 1:40 1:40 1:80	18	15	Bronchopneumonia l. dx.	I	9 days	1:40
				II	24 "	1:60
				III	1 1/2 months	1:40
				IV	7 "	1:15
				V	11 1/2 "	<1:10
1:80 1:30 <1:10 1:80 1:20	19	29	Bronchopneumonia l. sin. Meningitis serosa	I	5 days	1:60
				II	11 "	1:60
				III	1 month	1:30
				IV	9 1/2 months	1:20
				V	11 "	1:10
1:5 1:80 1:120 1:120 1:60	20	38	Bronchopneumonia l. sin.	I	2 months	1:80
				II	2 1/2 months	1:80
				III	3 1/2 "	1:60
				IV	11 1/2 "	1:10
1:40 1:40 1:30	21	82	Inf. ac.	I	4 days	1:10
				II	18 "	1:40
				III	1 1/2 months	1:20
1:80 1:40 1:40	22	20	Bronchopneumonia l. sin.	I	ca. 1 month	1:240
				II	1 1/2 months	1:160
				III	8 1/2 "	<1:10
1:20 1:40 1:30 1:10	23	19	Bronchitis ac.	I	10 days	1:20
				II	22 "	1:40
				III	8 months	<1:10
1:40 1:40 1:30 1:10	24	13	Sinuitis max. l.a. Meningitis serosa	I	7 days	1:40
				II	20 "	1:40
				III	1 month	1:20
				IV	7 months	<1:10
1:120 1:120 <1:10	25	8	Pneumonia l. dx.	I	18 days	1:40
				II	25 "	1:20
				III	3 months	1:10
				IV	6 1/2 "	1:10
1:120 1:120 1:60 <1:10	26	10	Inf. ac. resp.	I	ca. 1 month	1:80
				II	1 1/2 months	1:40
				III	2 "	1:20
				IV	7 "	<1:10

Case No.	Age, yrs.	Diagnosis	Serum No.	Period after Onset	Ornithosis CF Titer
27	13	Pneumonia l. dx.	I	ca. 1 month	1:40
			II	1 1/2 months	1:30
			III	3 "	1:10
			IV	7 "	<1:10
28	7	Bronchopneumonia l. dx.	I	ca. 1 month	1:120
			II	1 1/2 months	1:80
			III	7 "	1:10
29	27	Pneumonia l.a.	I	ca. 1 month	1:240
			II	1 1/2 months	1:240
			III	2 "	1:120
			IV	6 "	1:20
30	9	Pneumonia l.a.	I	ca. 1 month	1:160
			II	1 1/2 months	1:80
			III	2 1/2 "	1:40
31	10	Pneumonia l. dx.	I	2 days	1:30
			II	12 "	1:40
			III	1 1/2 months	1:40
			IV	5 "	<1:10
32	35	Infiltratio pulm. sin.	I	1 1/2 months	1:160
			II	2 "	1:160
			III	2 1/2 "	1:120
			IV	6 "	1:40
33	35	Bronchitis ac.	I	18 days	1:160
			II	1 1/2 months	1:160
			III	2 1/2 "	1:160
			IV	3 "	1:120
			V	5 "	1:40
			VI	7 "	1:20
34	3	Bronchopneumonia l. a.	I	5 days	1:40
			II	12 "	1:20
			III	1 1/2 months	1:10
			IV	3 "	<1:10
35	60	Bronchitis ac.	I	ca. 1 month	1:10
			II	1 1/2 months	1:40
			III	3 "	1:20

Case No.	Age, yrs.	Diagnosis	Serum No.	Period after Onset	Ornithosis CF Titer
36	26	Inf. ac.	I	3 days	1:60
			II	16 "	1:60
37	51	Pneumonia l. dx.	I	8 days	1:60
			II	22 "	1:40
			III	1 1/2 months	1:20
			IV	11 "	1:20
38	37	Bronchopneumonia l. sin.	I	13 days	1:40
			II	1 1/2 months	1:60
			III	11 "	1:40
39	8	Pleuritis et Pneumonia l. dx.	I	ca. 1/2 month	1:240
			II	1 "	1:240
			III	1 1/2 months	1:80
40	38	Bronchopneumonia l. sin.	I	ca. 1/2 month	1:60
			II	1 "	1:40
			III	9 months	1:20
41	2	Pleuropneumonia l. dx.	I	11 days	1:60
			II	20 "	1:80
42	4	Bronchopneumonia l. dx.	I	ca. 1 month	1:80
			II	1 1/2 months	1:80
43	7	Pleuropneumonia l. sin.	I	ca. 2 months	1:60
			II	2 1/2 months	1:40
			III	3 "	1:20
			IV	6 "	1:20

onset it was observed that antibodies were found already on the 1st to 7th days in 10 persons, and on the 8th to 14th days in 14 persons.

From figs. 8 and 9 and table 21 it is seen that in most cases the ornithosis antibody titer attained its peak already during the first three weeks after onset of the disease. The curve in fig. 8 which differs from the other curves (case 4) was obtained in case of a relapse. Three weeks after the reported day of onset, 80 per cent of the examined patients had a titer of  $\geq 1:40$  and 35 per cent  $\geq 1:80$ . Six weeks after onset the situation was almost similar, with

TABLE 21  
PATIENTS WITH ORNITHOSIS DISTRIBUTED BY ORNITHOSIS ANTIBODY TITER DETERMINED AT  
VARIOUS INTERVALS AFTER ONSET OF DISEASE

Time since Onset	Ornithosis CF Titer											Total
	<1:10	1:10	1:15	1:20	1:30	1:40	1:60	1:80	1:120	1:160	1:240	
3 weeks:												
Number ..	—	—	—	1	3	5	4	4	—	2	—	1
Per cent ..	—	—	—	5	15	25	20	20	—	10	—	5
									80 %	35 %		
6 weeks:												
Number ..	—	1	—	2	2	5	3	4	3	4	1	—
Per cent ..	—	4	—	8	8	20	12	16	12	16	4	—
									80 %	48 %		
3 months:												
Number ..	1	3	1	2	1	2	1	1	2	1	—	1
Per cent ..	6	19	6	13	6	13	6	6	13	6	—	6
									38 %	50 %	31 %	
5—7 months:												
Number ..	4	2	1	5	1	3	—	—	—	—	—	—
Per cent ..	25	13	6	31	6	19	—	—	—	—	—	—
									50 %			
11—17 months:												
Number ..	3	7	1	1	1	1	—	—	—	—	—	—
Per cent ..	21	50	7	7	7	7	—	—	—	—	—	—
									72 %			

the exception that high titers of  $\geq 1:80$  were obtained in more cases (48 per cent).

Following this, the antibody titer fell comparatively rapidly. Three months after onset only 31 per cent of patients had titer  $\geq 1:80$ , and in 38 per cent it was 1:10—1:20. High titers  $\geq 1:60$  were not encountered in a single case 5—7 months after onset, and antibodies were no longer found in 25 per cent of cases. Later 11—17 months from onset of the acute stage, 50 per cent had titer 1:10 and no antibodies were found in 21 per cent of patients then seen.

Concerning the maximum titer of individual patients it was observed to be  $\geq 1:80$  in 54 per cent and  $\geq 1:120$  in 36 per cent of patients (table 22). The highest antibody titers were seen in patients who had been ill at home for a long time without adequate treatment (cases 2, 4, 16, 17, 29 and 32).

TABLE 22  
PATIENTS WITH ORNITHOSIS DISTRIBUTED BY HIGHEST ORNITHOSIS ANTIBODY TITER

Patients	Highest Ornithosis CF Titer							Total
	1:40	1:60	1:80	1:120	1:160	1:240	1:320	
Number	11	9	8	5	5	3	2	43
Per cent	25	21	18	12	12	7	5	100

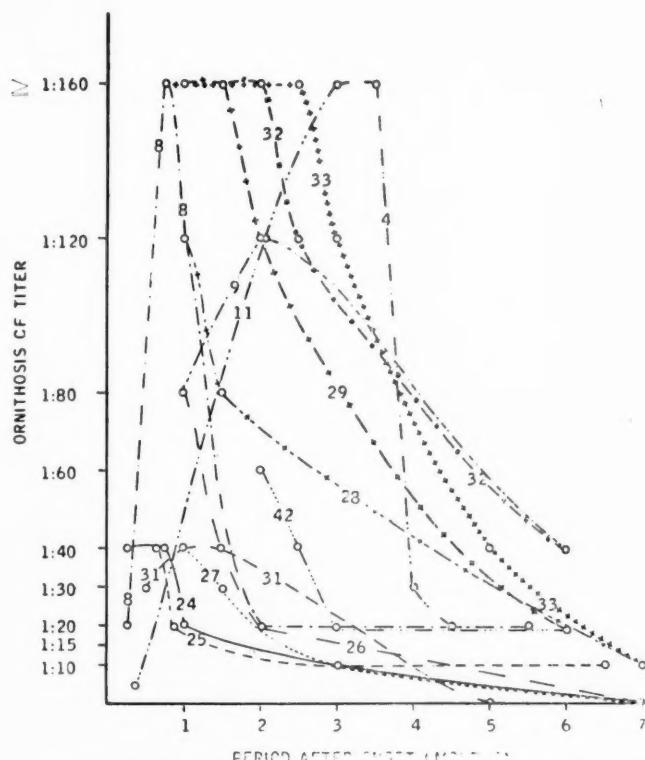


Fig. 8. — Ornithosis antibody titers in 12 patients followed for 4—7 months  
Numbers are case numbers

#### OTHER SEROLOGIC EXAMINATIONS

In the case of patients in the adult wards of the Aurora Hospital, only the Sitolipin test (118) is made as a routine examination for syphilis. It was therefore considered necessary to examine later the WaR, WaR chol., Kahn and Sitolipin reactions of those adult and child patients with ornithosis whose serum samples had not

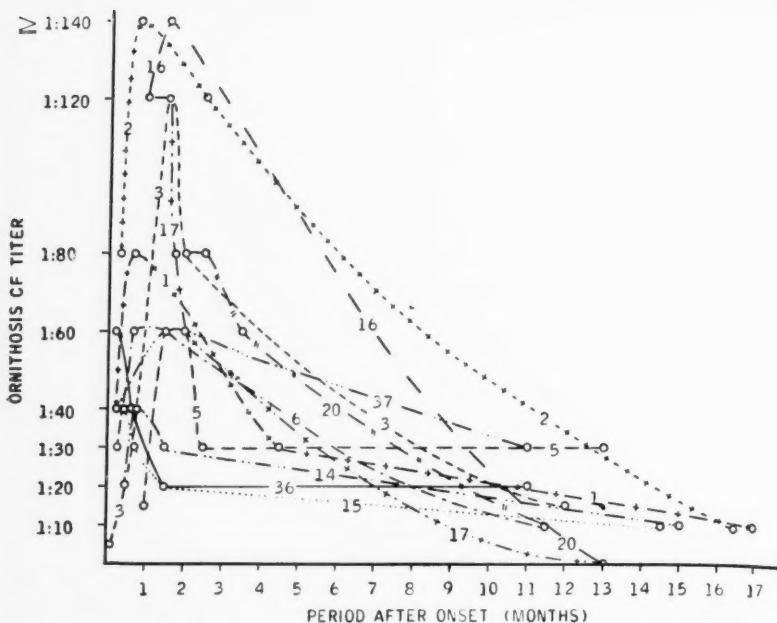


Fig. 9. — Ornithosis antibody titers in 12 patients followed for 11—17 months

been depleted. The tests were made in the Department of Serology and Bacteriology of the University of Helsinki and in the State Serum Institute. Of the 29 patients examined, 10 (34 per cent) gave a positive WaR, WaR chol. and/or Kahn reaction (cases 4, 7, 8, 9, 17, 22, 24, 28, 29 and 40). The Sitolipin test was negative in all examined cases, which seems to be additional evidence supporting the specificity of the Sitolipin test for syphilis. Table 23 shows the positive WaR results correlated to the ornithosis titers. In 3 cases (cases 4, 8 and 24) the WaR was found to become positive 3 months, 3 weeks and 4 weeks, respectively, from onset of the disease. Relapse had occurred in the first mentioned case. In one case (case 7) WaR chol. was still positive 2 months after onset, when the ornithosis titer had dropped to 1: 15.

The Kivelä Hospital, Helsinki, continues to make the above mentioned four tests for syphilis as a routine for all patients. In this hospital were treated the two patients in this series who were found to have pneumonia and to give a positive Wassermann test without base in the case history (cases 9 and 17). This had created a suspicion of ornithosis in the minds of the clinicians treating these patients. Both cases gave positive Kahn and WaR chol.; ordinary

TABLE 23

CORRELATION OF POSITIVE TESTS FOR SYPHILIS WITH ORNITHOSIS ANTIBODY TITERS

Case No.	Ornithosis CF Titer	WaR	WaR Chol.	Kahn	Sitolipin
4	1:5	—	—	—	—
	1:320				
	1:160	—	+	—	—
	1:30				
7	1:15				
	1:60		+	—	—
	1:15	+	+	—	—
8	1:20	—	—	—	—
	1:160	+	+	—	—
	1:20				
9		—	+	±	—
		—	+	+	—
		—	+	—	—
	1:80	—	—	—	—
	1:120				
17		—	+	+	—
		—	+	++	—
		—	+	+	—
	1:120	—	+	—	—
	1:120	—	—	—	—
	1:60	—	—	—	—
22	1:240				
	1:160		+		
24	1:40	—	—	—	—
	1:40		+?		
	1:20				
28	1:120	—	+		—
	1:80	—	—	—	—
29	1:240	+	+		
	1:240				
	1:120				
40	1:60	—?	+	—	—
	1:40				

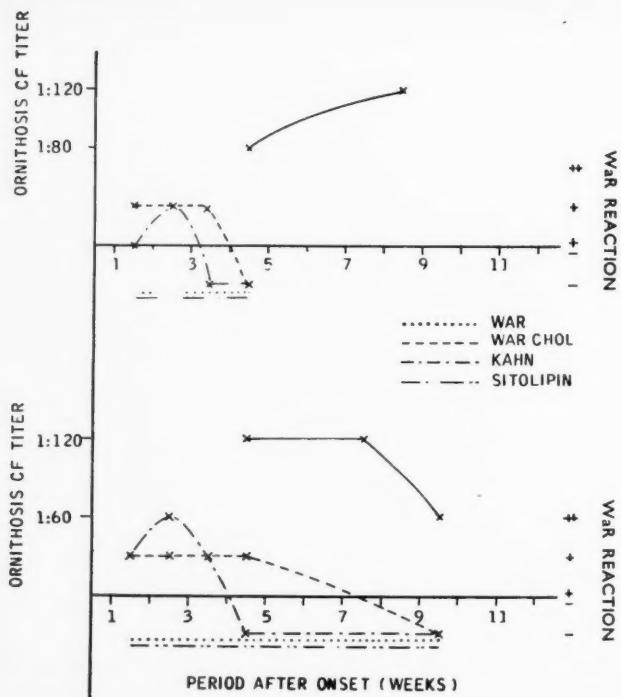


Fig. 10. — Correlation of tests for syphilis with the ornithosis antibody titer in 2 patients

WaR and Sitolipin were negative. About two weeks later the Kahn test was negative in both cases. WaR chol. was negative one month after admission in the first mentioned case and two months after admission in the latter case. Both patients still showed at the time high ornithosis antibody titers (fig. 10).

In the course of the work the routine collection of serum samples brought the paired serums of two patients with a diagnosis of tertiary syphilis and acute respiratory infection. The first and second serums of both patients had high ornithosis antibody titers (1: 320 and 1: 80, respectively) but their serums gave a positive reaction also with ornithosis control antigen. These patients were therefore excluded from the series. Additionally, the WaR positive serums of four patients under treatment for syphilis were examined. These serums gave negative results with both ornithosis antigen and control antigen.

Adenovirus antibodies were examined in the serums of 38 patients with ornithosis, using the complement fixation technique. An

TABLE 24  
PATIENTS WITH ORNITHOSIS DISTRIBUTED BY ADENOVIRUS ANTIBODY TITER OF  
SECOND SERUM

Patients	Adenovirus CF Titer							Total
	≤ 1:4	1:8	1:16	1:32	1:64	1:128	≥ 1:256	
Number	19	3	11	2	3	—	—	38
Per cent	50	8	29	5	8	—	—	100

adenovirus antibody titer of  $\leq 1: 16$  was found in the second serum of 87 per cent of these patients (table 24). Three patients had the same titer, 1: 64, in the first and second serums. None of the patients showed a significant rise in adenovirus antibodies.

The adenovirus antibodies were examined in 563 patients in the total series. In 30 cases (5.3 per cent) a significant increase or decrease in the adenovirus antibody titer was obtained. None of these patients showed a significant rise or fall in the ornithosis antibody titer. The ornithosis antibody titer of the second serum was  $< 1: 10$  in 26 persons, 1: 10 in 2 persons, and 1: 20 in 2 persons.

In the course of the work a case with an over eightfold rise in the ornithosis antibody titer was encountered, but since the patient evidently also had an adenovirus infection the case was not included in the series.

Hospital report A 3774/59. The patient was a 5-year-old boy, whose sister had had diarrhea one week previously. Before admission he had had continuous vomiting and fever during 4 days. Rectal temperature was 39.6°C, the patient was tired, his skin felt dry, and ESR was 17 and the white cell count 3,900. No chest x-ray was made. The fever subsided in the hospital within 2 days without antibiotics. The adenovirus antibodies were 1:64 5 days after onset of the disease and  $\geq 1: 256$  17 days after onset. The ornithosis antibodies were  $< 1: 10$  and 1: 80. Adenovirus type 7 was isolated from the feces.

Q fever antibodies were examined in the serums of 16 patients with ornithosis. None of the patients showed Q fever antibodies.

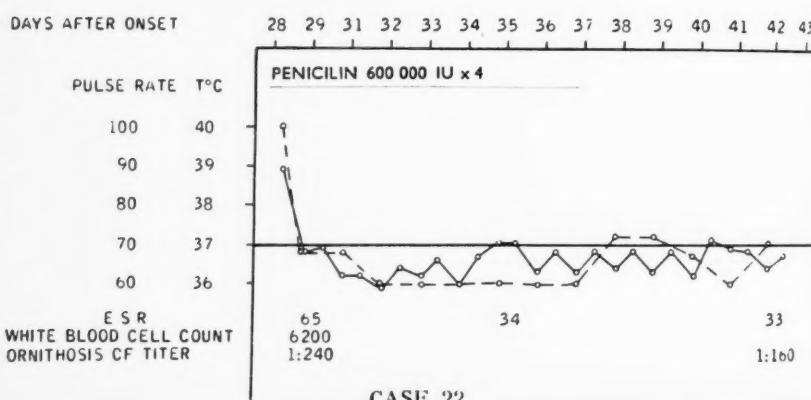
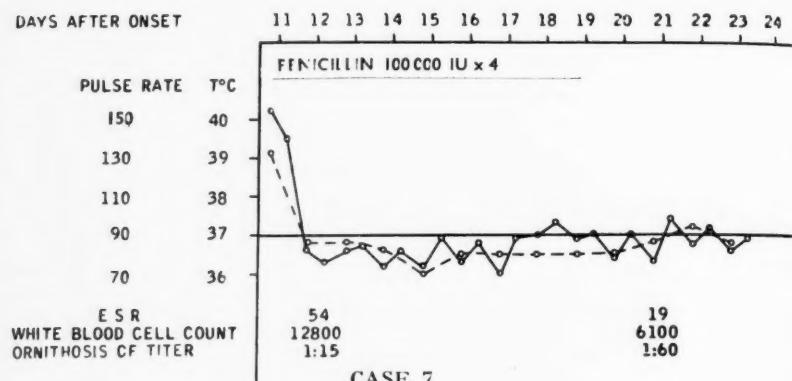
#### TREATMENT

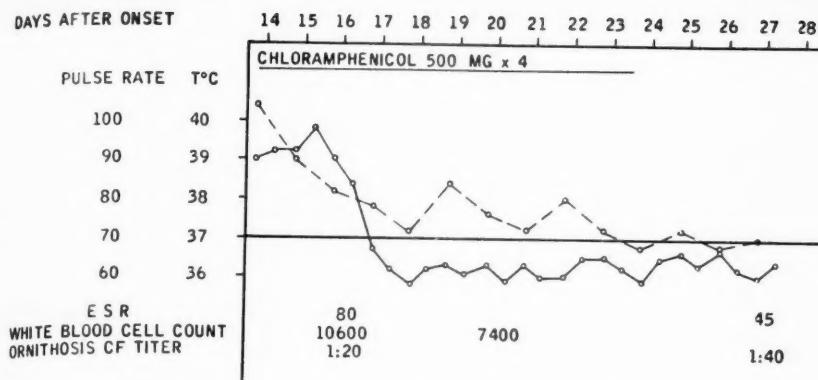
Medical treatment for at least 5 days was considered adequate. The criterion of the effect of the antibiotic was subsidence of the fever and reduction of the roentgenologic lung changes during or immediately following the treatment.

Penicillin treatment for the stated time was given to 20 patients, and appeared to be effective in 15 cases (75 per cent).

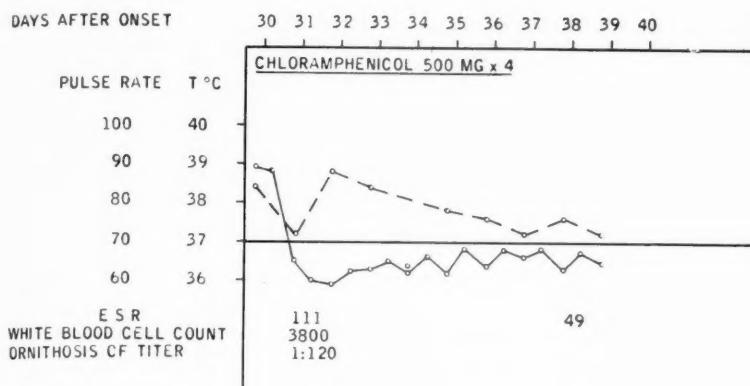
Seven patients were given an effective penicillin + streptomycin therapy. Chloramphenicol was found effective in 13 cases out of 14 (93 per cent). Six patients received tetracycline therapy, during which recovery began. One patient (case 12), to whom 5-day penicillin and 10-day chloramphenicol treatments brought no relief, began to recover with streptomycin administration (1.0 gm given once daily during 2 weeks). Sulphonamides gave poor results when used in 1 case. Examples of the effect of the different antibiotics on the fever curve are shown in fig. 11.

In the dosage of the antibiotics certain general principles were followed as closely as possible. The daily doses for children were as follows: V penicillin, 20,000—25,000 IU/kg; streptomycin, 20—30 mg/kg; chloramphenicol, 40—50 mg/kg; and tetracycline 15 mg/kg. For adults the usual daily doses were: V penicillin, 1.2 million IU orally, or procaine penicillin, 600,000 IU intramuscularly; chloramphenicol, 0.5 gm four times daily on the first days and 0.25 gm four times daily thereafter; and tetracycline, 0.25 gm four times daily.

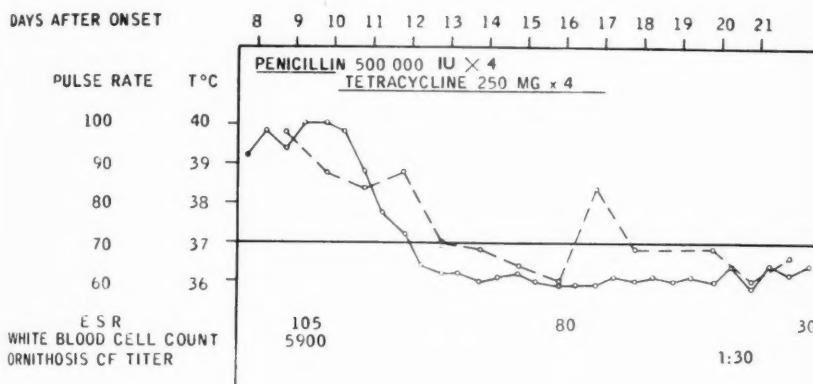




CASE 14



CASE 17



CASE 13

Fig. 11. — Effect of antibiotic therapy on the fever curve and pulse rate of 5 patients with ornithosis

— = Temperature  
— = Pulse rate

## CASE REPORTS

None of the patients with ornithosis had during the preceding 6 months suffered from a respiratory infection of long duration which had become cured in the meantime.

*Case 1.* Hosp. rep. A 4237/58. The patient was a restaurant worker, female, aged 17. No contact with birds was reported. Some of her fellow workers had a common cold at the time of onset of her disease. On Oct. 28, 1958 there suddenly was a severe pain on the right side on breathing and the temperature was 38.5°C. Intramuscular administration of penicillin was begun on the following day. Since fever and pain persisted, the patient was admitted to the Aurora Hospital with the diagnosis: Cholecystitis ac.? Pleuritis incipiens ldx.?

On admission T.ax. was 37.7°C and a cold and cough were present. The patient's general condition was moderately good. Laterally over the left lung there was a slight relative dullness and a somewhat depressed breath sound. ESR was 96 and the leukocyte count 10,300. Thorax x-ray on Nov. 3 showed in the posterobasal segment of the right lower lobe increased configuration adjacent to the hilus. The changes pointed mostly to a post-pneumonic condition in the right lower lobe.

The penicillin treatment was continued orally during 10 days. The fever subsided after commencement of the antibiotic therapy. On Nov. 10 only a slight increase in the configuration remained in the roentgenogram and ESR was 47. She was discharged on Nov. 11 and had a further 10 days of sick leave but felt weak even thereafter.

The ornithosis antibody titer was on Nov. 2, 1958, 1: 40; Nov. 15, 1: 80; March 9, 1959, 1: 30; March 18, 1960, 1: 10.

*Case 2.* Hosp. rep. A 4664/58. This was a 10-year-old girl living in a house where there were numerous pigeons in the yard and on the roof. Her mother had had a cough at about the same time. On Nov. 20, 1958 a severe non-productive cough developed and the temperature was 38°C. Following the administration of aspirin the fever subsided but coughing persisted. On her return to school, pneumonia was diagnosed by the school doctor, who sent her to hospital.

On admission T. rect. was 37.7°C. Her general condition was comparatively good but she coughed frequently. The rate of respiration was 26/min. Rales were heard over the lower posterior field of the left lung. ESR was 8 and the leukocyte count 5,600. Thorax x-ray on Nov. 29 revealed fine bands in the parenchyma of the posterobasal segment of the left lower lobe. The x-ray diagnosis was Bronchopneumonia lob. inf. l.sin.

Intramuscular injections of penicillin were given on 6 days. Already on the second day in hospital the patient was afebrile. Control x-ray on Dec. 9 showed that the bandlike pulmonary infiltration had almost completely disappeared. ESR was 5. She was discharged on Dec. 11 but felt fatigued for several weeks.

The ornithosis antibody titer was on Nov. 29, 1958, 1: 80; Dec. 9, 1958, 1: 320; Feb. 5, 1959, 1: 120; March 30, 1960, 1: 10. The girl's mother had an antibody titer of 1: 15 on Feb. 5, 1959.

*Case 3.* Hosp. rep. A 846/59. The patient was a disinfector, aged 49, one of whose duties was to reduce the number of pigeons in Helsinki. On Feb. 13, 1959 the patient had chills; on the following day the temperature rose to 40°C and there was pain in the limbs, slight headache, and the eyes were somewhat sensitive to light. He had a mild cold but no cough. He was admitted on the same day.

On Feb. 15 T. ax. was 39.6°C. He was in a good general condition but was now coughing. Breath sound was slightly depressed in the lower field of the right lung. ESR was 44 and the leukocyte count 5,900. Thorax x-ray on Feb. 17 revealed pneumonic infiltration in the parenchyma of the posterobasal segment of the right lower lobe.

Treatment was begun with a suspension of penicillin and streptomycin on 3 days. Since the fever did not subside tetracycline was substituted but had to be discontinued 2 days later because of a rash on the patient's body and extremities. The temperature had reverted to normal after 1 day's tetracycline administration. On Feb. 23 ESR was 53. Two days later he was discharged for treatment at home.

On March 9 he was examined in the outpatient clinic. ESR was 20 and the chest radiogram showed marked clearing and reduction in size of the pneumonic infiltration in the parenchyma. Further clearing was observed on March 23, and on April 4 no foci remained in the thorax x-ray. ESR was 13. The patient complained of fatigue for a long time.

The ornithosis antibody titer was on Feb. 15, 1959, 1: 5; March 9, 1: 30; April 3, 1: 120; April 15, 1: 80; Feb. 8, 1960, 1: 15.

*Case 4.* Hosp. rep. ESKS 2674/59, 5161/59. A 9-year-old farmer's boy living in the rural commune of Lemi, in south-eastern Finland, had a history of cough since mid-March 1959 and febrile temperatures up to 39°C since March 20. Penicillin-sulphonamide tablets given on 3 days gave no relief. He was admitted to the South Saimaa Central Hospital on March 23.

On admission T. rect. was 37.6°C, and the patient had a cold and cough. There was a relative dullness over the posterior lower portion of the left lung and moist rales. ESR was 66 and the leukocyte count 9,900. The chest x-ray diagnosis was Bronchopneumonia l.sin. Penicillin was administered intramuscularly during one week. On March 30 T. rect. was 37.6°C. He was coughing less and on March 31 he was discharged for home treatment.

On April 6 he was examined at the outpatient clinic. Some rales were still heard but the roentgenologic changes had diminished. The cough persisted at home.

He was readmitted on June 17 because of fever up to 38°C during one week. On admission T. rect. was 37.8°C. He was in a moderately good

general condition but tired. Some medium rales were heard over the lower left lung field; in the right lower field the breath sound was weak. ESR was 32 and the leukocyte count 13,700. Thorax x-ray made on June 16 showed Bronchopneumonia l.dx. Penicillin-streptomycin suspension was administered during 10 days. On June 26 the lung changes were decreased in the radiogram. The boy was discharged for home treatment on June 27, 1959.

The ornithosis antibody titer was on March 24, 1959, 1: 5; June 18, 1: 320; June 29, 1: 160; July 25, 1: 30; Aug. 7, 1: 20. On March 24, the WaR, WaR chol., Kahn and Sitolipin tests were negative, but on June 29 WaR chol. was positive and the others negative.

*Case 5.* Hosp. rep. A 1572/59. This was a 3-year-old boy who had played in a park where there were many pigeons. His brother had also had a cough and fever at the same time. Since the beginning of March 1959 there had been fever up to 39°C, and he had a severe dry cough. A short treatment with chloramphenicol was without effect and hospitalization was recommended.

On admission on April 13 T. rect. was 38.1°C and he was in a moderately good general condition but coughing. Percussion and auscultation gave normal findings in the lungs. ESR was 12 and leukocytes were 5,100. The chest x-ray showed bandlike infiltration in the right middle lobe.

The patient received penicillin orally during one week. Fever was absent on the fifth day of hospitalization but the cough persisted. Chest radiograms on April 20 revealed increased infiltration in the base of both lungs. Slight infiltration was also seen in the upper lobes. On April 22 ESR was 20, on April 27 there was no cough. On May 4 ESR was 5 and in the radiograms the bandlike infiltration was clearly diminished in both lungs and was nearly absent in the upper lobes. On May 9 he was discharged to convalesce at home.

The ornithosis antibody titer was on April 6, 1959, 1: 15; April 17, 1: 60; April 28, 1: 60; May 8, 1: 30; March 21, 1960, 1: 30. The WaR, WaR chol., Kahn and Sitolipin tests made on April 17 and May 8 were negative.

*Case 6.* Hosp. rep. A 1483/59. The patient, a 56-year-old dressmaker, had had no contact with birds. On April 3 she became ill with cough and cold and on one day had a rise in temperature to 37.5°C. Chest x-ray on April 6 showed infiltration in the upper field of the left lung. Hospital examination was recommended.

On admission on April 6 T.ax. was 37.2°C. Her general condition was good but she had a slight cold and cough. Percussion and auscultation of the lungs gave a normal finding. ESR was 47 and the white cell count 5,400. Chest x-ray on April 7 revealed infiltration in the parenchyma of the left upper lobe spreading from the hilus and apparently inflammatory in nature. X-ray diagnosis was Pneumonia lobi sup.l.sin.

She received chloramphenicol therapy for one week. During hospitalization the temperature remained normal but ESR was 54—90—80. Control

x-rays on April 20 showed that the pneumonic infiltration was greatly diminished in size and density. On April 28 ESR was 51 and the patient was discharged as convalescent. On May 14 ESR was 26.

The ornithosis antibody titer was on April 8, 1959 1: 30; April 20, 1: 60; May 14, 1: 60; March 21, 1960, 1: 10. The WaR, WaR chol., Kahn and Sitolipin tests were negative on April 8, April 20 and May 14.

*Case 7.* Hosp. rep. A 4221/59. A boy aged 3 lived near a public feeding place for pigeons. On Sept. 28, 1959 he became ill with a cold, cough and fever and was treated at home with aspirin. Since the fever persisted he was sent to the hospital on Oct. 7.

On admission T. rect. was 40.2°C. His general condition was good but he had a cold and cough. Some crackling rales were heard over the right lung. ESR was 54 and the white cell count 12,800. On Oct. 8 the thorax x-ray showed density of the hilar regions, from which bandlike and patchy infiltration spread to the lingula, the left posterobasal region and slightly also into the right lung.

He was given penicillin orally during 8 days. The fever subsided in one day (fig. 11). On Oct. 17 ESR was 19 and the roentgenologic changes had almost completely disappeared. He was discharged as convalescent on Oct. 20.

The ornithosis antibody titer was on Oct. 8, 1959, 1: 15; Oct. 17, 1: 60 and Dec. 8, 1: 15. On Oct. 17 WaR chol. was positive, and on Dec. 8 WaR and WaR chol. were positive and Kahn and Sitolipin negative.

*Case 8.* Hosp. rep. A 4237/59. This was a watchmaker aged 39. In late Sept. 1959 the chimney flues in the house in which he lived on the top floor were cleaned and hundreds of dead pigeons were found in the flues. At the same time his wife also was ill with cough and fever. On Oct. 2 the patient had an onset of sore throat, cough and sensitivity of the eyes to light. On Oct. 5 his temperature was 38.4°C, followed by a subfebrile temperature of slightly over 37°C. One-third of his waking hours he was coughing. He medicated himself with Primal and a cough medicine. As pneumonia was suspected he was admitted on Oct. 8.

On admission T.ax. was 37.5°C and his general condition was moderately good. Moist rales were heard over the basal regions of both lungs, being more pronounced on the left. ESR was 19 and white cells numbered 6,400. Chest x-ray revealed effusion in both costophrenic sinuses and rather dense bandlike infiltration in both lower lobes. The hilar regions showed increased density. The interlobar pleura of the right lung was accentuated. X-ray diagnosis was Pleuropneumonia l.a.

The patient's temperature was normal in the hospital. Treatment consisted at first of penicillin given orally during 13 days. Chloramphenicol was substituted on Oct. 22, when infiltration was still seen in the radiograms. On Oct. 29 ESR was 20. X-ray on Nov. 3 showed further that the infiltration had diminished in both lungs but had not yet disappeared entirely. On Nov. 4 the patient was discharged as convalescent.

The ornithosis antibody titer was on Oct. 10, 1959, 1: 20; Oct. 20, 1: 160; Dec. 8, 1: 20; March 14, 1960, 1: 20. On Oct. 10 the WaR, WaR chol., Kahn and Sitolipin tests were negative, and on Oct. 22 WaR and WaR chol. were positive and Kahn and Sitolipin negative.

*Case 9.* Hosp. rep. K 4128/59. A 51-year-old dishwasher in a children's home was in the habit of feeding stale bread to pigeons in the Helsinki Market Square at the request of the matron. The latter, who also fed the pigeons, and the cook had had a long bout of coughing in the summer of 1959. In the beginning of September the patient had an onset of dry cough of a severity that she had never previously experienced, accompanied by hoarseness, occasional subfebrile temperatures up to 37.5°C, and pain in the left side.

When she was admitted on Sept. 21 T.ax. was 37.2°C and her general condition was moderately good. Crackling rales were heard over the entire area of both lungs. ESR was 41 and the leukocyte count was 10,000. In radiogram on Sept. 24 the lingula was atelectatic and infiltrated.

The patient was afebrile in the hospital and was given a long chloramphenicol therapy. On Sept. 30 ESR was 52. Control x-ray on Oct. 3 showed marked decrease of the infiltrative process. On Oct. 10 the previously atelectatic and infiltrated area showed only increased configuration. On Oct. 15 ESR was 36. On Oct. 20 the patient was discharged as convalescent but fatigue persisted for a long time.

The ornithosis antibody titer was on Oct. 17, 1959, 1: 80; Nov. 18, 1: 120; March 21, 1960, 1: 40. On Sept. 22 and 28 WaR chol. and Kahn were positive, and WaR and Sitolipin negative. On Oct. 1 the Kahn test had become negative. On Oct. 19 all these tests were negative.

*Case 10.* Hosp. rep. A 4706/59. Carpenter, aged 60. There was no information on contact with birds. He had been coughing for some time. On Nov. 7, 1959 his temperature was 38.5°C. Two days later there was pain on the right side and the employer's medical officer sent him to the hospital.

On admission T. ax. was 38.1°C. He was in a moderately good general condition but was coughing severely. Fine and medium rales were heard over the lower field of the right lung and especially over the side. ESR was 35 and the white cell count 10,400. Chest x-ray on Nov. 10 revealed slight pleural effusion anteriorly on the right, and bandlike infiltration also on the right, chiefly in the lower lobe.

Treatment was penicillin orally during one week. On Nov. 24 ESR was 26 and roentgenologically the posterobasal infiltration in the right lower lobe had mostly disappeared but some bands and patches till remained. On Nov. 24 the patient was discharged as convalescent.

The ornithosis antibody titer was on Nov. 10, 1959, 1: 40; Nov. 24, 1: 80 and Dec. 17, 1: 30.

*Case 11.* Hosp. rep. VKS 5807/B820/59. In this case of a 4-year-old boy there was no knowledge of contact with birds. On Nov. 10, 1959 he became ill with cough and on Nov. 12 his temperature was 40.1°C. He was admitted to the Vaasa Central Hospital on Nov. 13.

On admission T. rect. was 38.5°C. The patient was coughing and some moist rales were heard over both lungs. ESR was 40 and leukocytes were 8,600. Thorax x-ray on Nov. 16 showed enlargement of the right hilus, adjacent to which was an area of moderate density in the parenchyma, with indefinite margins, apparently pneumonic. He received penicillin-streptomycin suspension for one week. Four days after its institution he was afebrile and on Nov. 19 he was discharged as convalescent.

The ornithosis antibody titer was on Nov. 17, 1959, < 1: 10; Dec. 1, 1: 80 and Jan. 21, 1960, 1: 20.

*Case 12.* Hosp. rep. A 5533/59. A metal worker aged 52 had had no contact with birds. On Dec. 27, 1959 he became ill with cough, and fever was 39.6°C. He complained of pain on the left side and the sputum was slightly bloodstained. He was admitted on Dec. 29 with the diagnosis Pleuritis?

On admission T.ax. was 38.5°C. He was in a good general condition but was coughing. Laterally over the left lung the breath sound was slightly depressed; no rales were heard. ESR was 50 and the white cell count 12,300. X-ray made on Jan. 4, 1960 showed a slight pleural effusion in the left costophrenic sinus. In the apical and posterobasal segments of the left lower lobe there was diffuse infiltration, evidently caused by segmental pneumonia in at least two segments. The hilar regions were rather dense and the hilar nodes appeared hyperplastic. The x-ray diagnosis was Pneumonia l. sin.

Treatment was at first penicillin orally during 5 days. Fever subsided on the fourth day. On Jan. 4 chloramphenicol treatment was begun and continued for 10 days. On Jan. 11 ESR was 80. X-ray on Jan. 12 showed a cavity formation with a fluid surface in the area of the infiltration. Tomography on Jan. 15 revealed a tumor-like shadow with an irregular cavity in the center, which was not connected with the bronchus. The finding was tumor suspect and seemed to speak against a common abscess but not for tuberculosis. Tb therapy had been begun on Jan. 13. Mantoux test (0.01 mg) was 8 × 10 mm. Tbc-culture and three tumor cell samples from sputum were negative. ESR on Feb. 5 was 10. Chest x-ray on Feb. 8 seemed to show some pleural effusion remaining posteriorly on the left. The infiltration was greatly reduced in size, the cavity shadow was unchanged, but a definite fluid surface was not evident. On Feb. 25 the infiltration was distinctly circumscribed and homogeneous, a central cavity was not definitely seen. The infiltration was considered to be strongly tumor suspect. On March 15 the shadow in the left lower lobe had increased in density and had sharper margins, being now tumor suspect to a very high degree. Bronchoscopy gave normal findings. On March 19 the patient was discharged.

At follow-up examination at the outpatient clinic on April 13, ESR was 2. Compared with the preceding x-ray findings the infiltration in the left lower lobe was perhaps slightly smaller; at least no definite increase was observed. This was considered possibly only an inflammatory infiltration in view of the reduction in size. Tb treatment was discontinued. In x-ray

on May 23 the shadow was unchanged. On June 28 it was somewhat smaller, and the shadow was interpreted as a change due chiefly to infection.

The ornithosis antibody titer was on Dec. 30, 1959, 1: 5; Jan. 21, 1960, 1: 80; Feb. 13, 1: 120; Feb. 22, 1: 120; March 9, 1: 60; April 13, 1: 60 and May 23, 1: 40. A virus resembling that of *Herpes simplex* was isolated by the State Serum Institute from throat washing fluid obtained on admission of the patient to the hospital. Because of bacterial infection, typing of the virus was not possible.

*Case 13.* Hosp. Rep. A 440/60. A postman aged 49 had had no contact with birds. On Jan. 7, 1960 he became ill with fever, which on Jan. 11 was 40.2°C. On Jan. 14 he was also coughing, and since he lived alone he was admitted to the hospital with a diagnosis of acute infection.

On admission T.ax. was 39.8°C. The patient's general condition was good. Some medium rales were heard over the right upper field anteriorly. ESR was 105 and the white cell count 5,900. X-ray on Jan. 18 revealed rather dense infiltration spreading from the hilar region into the apical segment of the right lower lobe. The hilus showed considerable density. There was also some infiltration in the upper lobe. The changes seemed pneumonic (fig. 7).

The patient received at first penicillin orally on 2 days and then tetracycline during one week. Fever subsided 2 days after commencement of the tetracycline therapy (fig. 11). ESR was 80 on Jan. 22, and 30 on Jan. 29. X-ray on Jan. 28 showed nearly complete disappearance of the infiltration in the apical segment of the right lower lobe. On Jan. 31 the patient was discharged.

The ornithosis antibody titer was on Jan. 25, 1960, 1: 30; Feb. 6, 1: 80; Feb. 24, 1: 40; March 23, 1: 40. On Jan. 15 WaR, WaR chol., Kahn and Sitolipin were negative. On Feb. 6 WaR and WaR chol. were doubtfully negative.

*Case 14.* Hosp. rep. A 4991/58. A dressmaker, aged 43, had had no known contact with birds. Recently her children had had a cough and fever. On Dec. 12, 1958 she became ill with fever and a severe cough gradually developed. She received penicillin intramuscularly on 6 days but as the fever and cough persisted she was admitted to the hospital on Dec. 25.

On admission T.ax. was 39°C. She was in a rather serious condition and was coughing badly. The respiratory rate was 24/min. Medium rales were heard over the right lower field. ESR was 80 and the white cell count 10,600. Chest x-ray on Dec. 27 revealed some bandlike infiltration spreading from the hilus into both lower lobes and the right middle lobe. X-ray diagnosis was Pneumonia I.a. Clinically there was very severe bilateral pneumonia. High fever and serious condition continued for two days. She received chloramphenicol orally for 10 days, at first intramuscularly and later orally. On the fourth day she was afebrile (fig. 11). On Jan. 7 ESR was 45. Chest x-ray on Jan. 8 showed bilateral clearing of the basal infiltrations. The patient was discharged on the following day. At follow-up exami-

nation at the outpatient clinic on Jan. 20 ESR was 6 and clearing of the basal involvement had continued bilaterally.

The ornithosis antibody titer was on Dec. 27, 1958, 1: 20; Jan. 7, 1959, 1: 40; Jan. 20, 1: 30; March 16, 1960, 1: 10. On Dec. 27, 1958, Jan. 7 and Jan. 20, 1959 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

In Dec. 1959 there was a recurrence of pneumonia. The ornithosis antibody titer was 1: 10 on Dec. 12.

*Case 15.* Hosp. rep. A 413/59. A 35-year-old office cleark had had no contact with birds. On Jan. 6, 1959 she had a cough and fever 39°C. Beginning Jan. 7 she received chloramphenicol for 3 days and then penicillin orally for 5 days, with no relief. X-ray on Jan. 13 showed an infiltration in the right lung.

On admission on Jan. 16 T.ax. was 37.1°C. Her general condition was comparatively good but she was coughing considerably. There was relative dullness in the basal part of the right lung and medium rales. ESR was 90 and the white cell count 8,200.

She received tetracycline during 8 days and had no fever during hospitalization. On Jan. 27 ESR was 20 and x-ray examination showed only some traces of the bandlike infiltrations in the right lower lobe. The patient was discharged on Jan. 27. When re-examined on Feb. 10 in the outpatient clinic the roentgenologic changes had disappeared completely and ESR was 10.

The ornithosis antibody titer was on Jan. 17, 1959, 1: 40; Jan. 27, 1: 30; Feb. 10, 1: 20; March 16, 1960, 1: 10. The WaR, WaR chol., Kahn and Sitolipin tests were negative on Jan. 17, Jan. 27 and Feb. 10, 1959.

*Case 16.* Hosp. rep. A 1059/59. A charwoman, aged 44, was in the habit of feeding pigeons in the Hesperia Park in Helsinki. In the latter part of January 1959 she had a cough with high temperature. Coughing continued in February, with occasional rises in temperature. On Feb. 26 she became ill with high fever, which persisted at about 40°C. There was sensitivity of eyes to light, and a pain in the chest. On March 3, penicillin injections were prescribed, but with the fever still running high she was admitted to the hospital on March 5.

On admission T.ax. was 38.9°C. The condition of the patient was serious. There was relative dullness over the lower posterior parts of the lungs and medium rales were numerous. ESR was 111 and the white cell count 3,800. X-ray examination on March 9 showed bandlike infiltration in the parenchyma of the basal parts of both lungs, interpreted as a pneumonic process undergoing restitution in both lower lobes.

She received chloramphenicol during one week. The fever abated during the first 24 hours (fig. 11). On March 13 ESR was 49 and the patient was discharged on the following day. At follow-up examination in the outpatient clinic on March 19, ESR was 60 and roentgenologically the pneumonic process was restituted.

The ornithosis antibody titer was on March 6, 1959, 1: 120; March 19, 1: 160; March 14, 1960, < 1: 10. On March 6, 1959, the WaR, WaR chol., Kahn and Sitolipin tests were negative.

*Case 17.* Hosp. rep. K 1101/59. A 55-year-old bank clerk, female, had not been in contact with birds. In early February 1959 she became ill with cough, pain in the limbs, occasional vomiting and great malaise generally, but with only a slight rise in temperature to 37.5°C. On Feb. 17 she was admitted to the hospital for examination.

On admission T.ax. was 37.1°C. The patient's general condition was good but dry rales were heard over the posterior middle parts of both lungs, more loudly from the left lung. ESR was 52 and the white cell count 2,900. X-ray on Feb. 20 revealed bands and patches below the left hilus; in lateral projection they were localized to the apical segment of the lower lobe.

She had no fever in the hospital. Administration of penicillin-streptomycin suspension was begun on Feb. 24 and continued for 2 weeks. On March 17, ESR was 38. Infiltration was no longer seen in the left lung in x-ray examination on March 18. She was discharged on March 20 but suffered from fatigue for a long time.

The ornithosis antibody titer was on March 17, 1959, 1: 120; April 7, 1: 120; April 21, 1: 60; March 21, 1960, < 1: 10. Tests on Feb. 18 and 23, March 4 and 10, and April 14 and 21, 1959 gave negative WaR and Sitolipin reactions in all tests, a positive WaR chol. reaction in all but the last test, and Kahn reactions as follows: One plus, two plus, one plus, doubtful, negative, negative.

*Case 18.* Hosp. rep. A 1557/59. A girl aged 15 had had no known contact with birds. On April 3, 1959 she had a cough and on April 11 fever 40.3°C, headache and vomiting. She was admitted on the same day.

On admission T.ax. was 40.4°C. Her general condition was good. Percussion and auscultation of lungs gave normal finding. ESR was 23 and on April 17 the white blood cell count 5,300. X-ray on April 14 gave a normal finding. On April 17 there was an infiltration in the parenchyma of the apical segment of the right lower lobe and the interlobar pleura was thickened. Some density was seen in the right hilar region. The pleural shadow seemed to be accentuated in the right lower region. X-ray diagnosis was Pneumonia 1.dx.

The patient received penicillin intramuscularly during 5 days and, after diagnosis of the roentgenologic changes in the lungs chloramphenicol during one week. Fever had abated after 2 days on penicillin. ESR was 11 on April 20 and 4 on April 27. Control x-ray on April 29 showed only slight traces of bands in the right lung.

The ornithosis antibody titer was on April 12, 1959, 1: 40; April 27, 1: 60; May 11, 1: 40; March 16, 1960, < 1: 10. The WaR, WaR chol., Kahn and Sitolipin tests were negative on April 12 and 27 and May 11.

In October 1959 there was recurrence of pneumonia and the ornithosis antibody titer on Nov. 2 was 1: 15.

*Case 19.* Hosp. rep. A 1681/59. A 29-year-old taxicab driver had had no known contact with birds. One month previously his wife, son and brother's family had been ill with cold and fever. On April 16 he complained of nausea, headache and pain in the limbs. T.ax. was 37.6°C on April 19 and 40.1°C on the following day. There was stiffness of the neck and he was admitted to the hospital.

On admission T.ax. was 39°C. His neck was found to be stiff. There was no cough, and percussion and auscultation of the lungs gave normal findings. ESR was 7 and the white blood cell count 5,700. Lumbar puncture fluid on April 20 contained 6 cells and 3 days later 29 cells, of which 55 per cent were lymphocytes. Chest x-ray on April 24 revealed pneumonic infiltration in the parenchyma of the left lower lobe and thickening of the interlobar pleura in the right lung.

He received at first aspirin and codein. On the third day the temperature was normal. After the x-ray diagnosis of pneumonia, chloramphenicol therapy was begun on April 25 and continued for 6 days. On May 5 he was discharged. At follow-up examination in the outpatient clinic on May 13, ESR was 6 and x-ray showed post-pneumonic changes in the lower part of the left lung.

The ornithosis antibody titer was on April 21, 1959, 1: 60; April 27, 1: 60; May 13, 1: 30; Jan. 28, 1960, 1: 20; March 16, 1: 10.

*Case 20.* Hosp. rep. A 2161/59. This was an automobile driver aged 38. No contact with birds was reported. His daughter had a common cold at the time he became ill with fever on March 22, 1959. He received tetracycline at home during 4 days. On April 1-7 he underwent examination at the Aurora Hospital. He had no fever while in the ward and ESR declined from 36 to 20 without antibiotics. The white cell count was 6,200. X-ray finding was negative. A diagnosis of acute infection was made.

On May 21 there was a recurrence of fever of 39.5°C and a cough appeared. The sputum was bloodstained. He was rehospitalized on May 22. On admission T.ax. was 40°C. His general condition was good. He was coughing and a few moist rales were heard over the basal parts of both lungs. ESR was 14 and the white cell count 7,300. X-ray on May 23 revealed dense hilar regions and diffuse patchy infiltration in the parenchyma of the left lung. The infiltration was dense in the hilar regions and less marked in the periphery but it involved the entire lung. The picture resembled mostly inflammatory changes due to pneumonia. Tuberculosis was also held in mind.

The patient received penicillin orally for 12 days. The temperature became normal 4 days after commencement of the therapy. ESR increased from 25 to 30 to 34. X-ray on June 4 showed greatly diminished infiltration. He was discharged on June 13 but convalescence was slow. When re-examined on July 3, ESR was 8 and the left lung showed in x-ray some traces left by inflammation.

The ornithosis antibody titer was on May 22, 1959, 1: 80; June 5, 1: 80;

July 3, 1: 60; March 3, 1960, 1: 10. On May 22 and July 3 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

The ornithosis antibody titer of the patient's daughter on March 15, 1960 was 1: 5.

*Case 21.* Hosp. rep. A 2428/59. A woman aged 82, concerning whose contact with birds there was no information, had on June 7, 1959 a temperature of 39.8°C. There was no cold or cough. She was hospitalized on the same day.

On admission T.ax. was 37.2°C. Her general condition was serious. Percutory and auscultatory findings of the lungs were normal. ESR was 30 and the white cell count 16,600. X-ray on June 13 showed bands with fairly sharp margins in the apex of the right lung and pleural thickening. X-ray diagnosis was *Suspicio pneumoniae 1.dx.*

She received penicillin orally for 12 days. The temperature was normal 4 days after commencement of treatment. ESR declined from 62 to 55. X-ray on June 26 showed no change from the preceding examination. She was discharged on July 14.

The ornithosis antibody titer was on June 11, 1959, 1: 10; June 25, 1: 40; July 13, 1: 20. On July 13 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

*Case 22.* Hosp. rep. A 3152/59. A 20-year-old saleswoman with no contact with birds developed a severe cough in early July 1959. On July 27 the temperature was elevated up to 39.2°C. On the following day the employer's medical officer sent her to the hospital.

On admission T.ax. was 39°C. Her general condition was good. Numerous rales were heard over the left lung. ESR was 65 and the white cell count 6,200. X-ray on July 29 revealed a pneumonic infiltration in the parenchyma of the left base, from which bandlike infiltrations extended towards the hilar region. Roentgenologic changes were found in the left maxillary sinus and pus was obtained on puncture.

She received penicillin orally for 10 days. Fever abated in one day (fig. 11). In x-ray on Aug. 7 the changes in the lung were diminished. ESR on Aug. 12 was 33. She was discharged on the following day. One month later the chest x-ray was negative.

The ornithosis antibody titer was on July 29, 1959, 1: 240; Aug. 10, 1: 160; March 16, 1960, < 1: 10. A positive WaR chol. reaction was obtained on Aug. 10.

*Case 23.* Hosp. rep. A 3204/59. This saleswoman aged 19 spent much time during summer in the Seurasaari Park, where there are numerous birds. Her husband also had a cold at the time that she developed a severe common cold on July 24, 1959. Two days later she was also coughing hard. On July 31 her temperature was 40°C and she complained of headache and aching limbs. On Aug. 1 there was pain in the right scapular region. She was admitted on the same day since pneumonia was suspected.

On admission T.ax. was 39.2°C. Her general condition was serious. She had a cold and cough, and the breath rate was 24/min. Some rales were heard over the right posterobasal region. ESR was 48 and the white cell count 7,800. X-ray on Aug. 4 did not reveal definite changes in the lung parenchyma but the vascular configuration of the lungs was accentuated and enlarged lymph node shadows were seen in the hilar regions, especially on the left. X-ray diagnosis was Hyperplasia lgl. bronch. praecer-tim l.sin. »Bronchitis». Both maxillary sinuses showed roentgenologic changes and puncture yielded pus. The patient received penicillin orally for 10 days. Temperature returned to normal in 2 days. ESR was 21 on Aug. 15, when the patient was discharged.

About 2 weeks later there was a recurrence of fever and cough, which yielded to penicillin therapy.

The ornithosis antibody titer was 1: 20 on Aug. 3, 1959; Aug. 15, 1: 40; March 30, 1960, < 1: 10.

*Case 24.* Hosp. rep. A 3717/59. A 13-year-old girl was not known to have had contact with birds. She had a cold throughout the summer 1959. On Aug. 29 she became ill with cough and fever up to 39.5°C. On Sept. 3 there was onset of headache, vomiting and nosebleed. She was admitted on Sept. 4.

On admission T. rect. was 39.1°C. Her general condition was good. She had a severe cold and was coughing in paroxysms. The respiratory rate was 28/min. Percussion and auscultation of the lungs gave normal findings. Slight stiffness of the back and neck were observed. ESR was 27 and the white cell count 6,200. The lumbar puncture fluid on the day of admission yielded 255 cells (90 per cent neutrophils and 10 per cent lymphocytes). On Sept. 7 the cerebrospinal fluid contained 16 cells. X-ray on Sept. 9 was negative. Roentgenologic changes were seen in both maxillary sinuses and pus was obtained on puncture.

On Sept. 6 her temperature was normal but the cough persisted. Tetracycline therapy instituted on Sept. 11 because of sinuitis was continued for 8 days. On Sept. 17 ESR was 17 and she was coughing less. On the following day she was discharged as convalescent.

The ornithosis antibody titer on Sept. 4, 1959 was 1: 40; Sept. 17, 1: 40; Sept. 25, 1: 20; March 21, 1960, < 1: 10. On Sept. 4 the WaR, WaR chol., Kahn and Sitolipin tests were negative. On Sept. 25 the WaR test was doubtfully positive.

*Case 25.* Hosp. rep. A 3910/59. An 8-year-old girl who had been playing with pigeons on Wallin and Alppi Streets, became ill with cough on Aug. 30, 1959. On Sept. 11 the temperature was 40°C and there was pain in her right side. Nosebleed appeared on 2 days. On Sept. 14 oral penicillin therapy was begun.

On admission on Sept. 16 T.rect. was 37.3°C. She was in a moderately good general condition. She had a cold and cough and some rales were heard over the right lung. ESR was 67 and the white cell count 7,800. X-ray

on Sept. 17 revealed increased hilar markings on both sides and fairly numerous bandlike infiltrations extending posterobasally from the right hilus and partly invading also the parenchyma. The findings were interpreted as bronchopneumonia.

The patient was without fever throughout her hospitalization. The penicillin therapy was continued for a further 8 days. On Sept. 24, ESR was 37. X-ray on Sept. 26 showed that the changes had disappeared almost completely and she was dismissed on the same day. On Oct. 6, ESR was 17.

The ornithosis antibody titer was on Sept. 17, 1959, 1: 40; Sept. 24, 1: 20; Nov. 30, 1: 10; March 17, 1960, 1: 10. On Sept. 17 and Nov. 30 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

*Case 26.* Hosp. rep. A 3998/59. A girl aged 10 had had no contact with birds. Her illness began in the beginning of September with a cold and cough and on Sept. 21 the temperature was elevated to 38°C. She received sulphonamides during the period Sept. 10—22. With the cough and fever persisting, she was admitted on Sept. 22.

On admission T.rect was 38.9°C. Her general condition was good, but she had a cold and cough. Percussion and auscultation gave no pathologic findings in the lungs. ESR was 16 and the white cell count 3,000. No chest x-ray was taken. The clinical diagnosis was acute respiratory infection.

In the hospital the fever remained elevated for 2 days but then abated without antibiotic therapy. She still had a cough when discharged on Sept. 28. At follow-up examination in the outpatient clinic on Oct. 5, ESR was 10 and the cough and cold persisted, without fever. She continued to cough for several weeks.

The ornithosis antibody titer was on Sept. 23, 1959, 1: 80; Oct. 5, 1: 40; Oct. 27, 1: 20; March 16, 1960, < 1: 10. The WaR, WaR chol., Kahn and Sitolipin tests were negative on Sept. 23 and Oct. 5.

*Case 27.* Hosp. rep. A 4254/59. This was a 13-year-old girl of whose contact with birds nothing is known. Her illness began in early September with a cough, which was refractory to cough medicines. Her temperature was not measured and she continued to attend school. X-ray on Oct. 6 revealed in the posterobasal segment of the left lower lobe a fairly large amount of patchy infiltration which was partly connected with the hilus. The right lung also showed patchy infiltration spreading from the hilus and projected in the lateral view chiefly to the apical segment of the lower lobe. X-ray diagnosis was Pneumonia lobi inf. l.a.

She was admitted on Oct. 9, with T.rect. 37.7°C, a cold and cough, and a dull percussion sound over the left lung posteriorly. No rales were heard. ESR was 35 and the white cell count 6,200. Both maxillary sinuses showed roentgenologic changes and on puncture yielded pus.

She received penicillin orally during 8 days. The temperature was normal from the second day onward. On Oct. 24 ESR was 17. X-ray on Oct. 22 showed that the lung changes had decreased. Some bandlike infiltra-

tions still remained and the left lung showed even some atelectasis but the patchy shadows had disappeared. On Oct. 27 the patient was dismissed as convalescent.

The ornithosis antibody titer was on Oct. 10, 1959, 1: 40; Oct. 19, 1: 30; Dec. 1, 1: 10; March 16, 1960, <1: 10. On Oct. 10 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

*Case 28.* Hosp. rep. A 4142/59. A boy aged 7 who had had no contact with birds became ill with cough and fever in early September 1959. X-ray on Sept. 16 revealed some density in the hilar regions and increased perihilar markings. Bandlike and patchy infiltration, within which were some translucencies, spread from the right hilus into the middle lobe. The right lower lobe also showed some bandlike and patchy infiltration in the parenchyma. On Oct. 2 the boy was admitted to the hospital.

On admission T.rect. was 37.3°C, he had a dry cough and a few whistling rales were heard throughout both lungs. ESR was 19 and the white cell count 9,400. While he was in the hospital T.rect. rose on Oct. 8 to 38.2°C. X-ray on Oct. 6 showed in the area of the right middle lobe rather profuse bandlike and patchy infiltration, with small cavities here and there. Chloramphenicol therapy lasting one week was begun on Oct. 7. The cough was nearly cured by Oct. 14. X-ray diagnosis on Oct. 14 was Hyperplasia Igll. bronch.lidx. ESR had declined during hospitalization from 19 to 4. The patient was discharged on Oct. 15.

The ornithosis antibody titer was on Oct. 10, 1959, 1: 120; Oct. 22, 1: 80; March 22, 1960, 1: 10. On Oct. 10, WaR chol. was positive and WaR and Sitolipin tests negative (no Kahn test); on Oct. 22 the four tests were negative.

*Case 29.* Hosp. rep. A 4483/59. This 27-year-old advertising designer, female, had had no contact with birds. Prior to her illness, two of her colleagues had suffered from cough with fever one week apart. In the summer of 1959 she had had cough with a slight rise in temperature. In the end of September the cough became more severe and evening temperature was ca. 38°C. About Oct. 10 she felt pain in the chest. Chloramphenicol was prescribed by a physician but after receiving it on 2 days she developed a rash on her hands. X-ray on Oct. 22 showed infiltration in both apices, leading to a suspicion of tuberculosis. The patient was admitted for this reason on Oct. 24.

On admission she had no fever and was in a satisfactory general condition but was coughing severely. Percussion and auscultation of the lungs were negative. ESR was 15 and the white cell count 5,900. The patient received tetracycline during one week. ESR dropped from 15 to 2. X-ray on Nov. 5 showed nearly complete disappearance of the infiltration. She was discharged on Nov. 7 but complained of fatigue for some time.

The ornithosis antibody titer was on Oct. 26, 1959, 1: 240; Nov. 7, 1: 240; Nov. 25, 1: 120; March 21, 1960, 1: 20. On Oct. 26, WaR and WaR chol. were positive.

*Case 30.* Hosp. rep. A 4471/59. The case history of this 9-year-old girl with a diagnosis of Pneumonia l.a. has been lost and the patient has moved to another locality.

The ornithosis antibody titer on Oct. 30, 1959 was 1: 160; Nov. 9, 1: 80; Dec. 14, 1: 40.

*Case 31.* Hosp. rep. A 4603/59. This was a boy aged 10 living in the suburb Maunula, who in the autumn of 1959 had carried numb small birds into an attic where there also were numerous pigeons. Many of the birds died in September. His illness began with vomiting during the night of Oct. 30; on the following morning his temperature was 37.8°C and in the evening 40.8°C. He was disoriented and did not recognize his mother. A physician prescribed penicillin orally. On Nov. 2 he vomited continuously and was somnolent. In the evening he was disoriented and had hallucinations, and was admitted to the hospital.

On admission T.rect. was 37.7°C. The patient was somnolent. The neck was not stiff. He coughed slightly. Dry, whistling rales were heard over both lungs. ESR was 75 and the white cell count 17,700. Chest x-ray on Nov. 4 showed in the posterior segment of the right upper lobe a homogeneous density, which in part was infiltrative and in part probably atelectatic. The right hilus was enlarged. X-ray diagnosis was Pneumonia segm. post. lobi sup. l.dx.

He received penicillin intramuscularly during 8 days. Fever abated 2 days after commencement of the therapy, the cough disappeared rapidly and ESR fell from 75 to 17 to 13. In x-ray on Nov. 20 the infiltration was decreased. On Nov. 21 the boy was discharged. Chest x-ray on Dec. 12 showed no infiltration in the right upper lobe.

The ornithosis antibody titer was on Nov. 3, 1959, 1: 30; Nov. 12, 1: 40; Nov. 21, 1: 40; March 21, 1960, < 1: 10.

*Case 32.* Hosp. rep. A 4893/59. This was a doctor of political science, male, who had had no contact with birds. His illness began on Oct. 11, 1959 with a chill followed shortly by cough and hoarseness. On Oct. 24 the temperature was 38°C and there was pain in the chest. Penicillin tablets prescribed by a physician lowered the temperature to normal in 5 days. In the middle lobe of the left lung there was infiltration with a small translucency. Since the shadow did not disappear the patient received chloramphenicol during 3 days, followed by penicillin orally up to Nov. 16. On Nov. 20 he was admitted to the hospital.

On admission he was in a good general condition, but was coughing slightly. Some dry rales were heard over the left lung laterally. ESR was 10 and the white cell count 4,000. Tomography on Nov. 23 revealed a rather dense and in some tomograms a fairly well-defined shadow in the region of the lingula. External to the shadow, however, there was reaction, and the corresponding portion of the pleura showed signs of irritation. The changes appeared to be chiefly inflammatory, but tuberculosis was also held in mind. A peripheral tumor was also considered possible but the tomograms did not support this opinion. Mantoux test (0.1 mg) 6 × 7 mm.

Commencing on Nov. 28 the patient received tetracycline during 10 days and tb therapy. X-ray on Dec. 11 showed notable reduction of the infiltration in the lingula. He was discharged on Dec. 16. In mid-January 1960 the chest x-ray was negative and tb treatment was discontinued.

The ornithosis antibody titer was on Nov. 21, 1959, 1: 160; Dec. 4, 1: 160; Dec. 20, 1: 120; March 30, 1960, 1: 40.

*Case 33.* This was a nurse aged 35 who was employed in the bacteriologic laboratory where the present investigation was being made but did not work with the pigeons. In early November 1959 she complained of fatigue, and beginning with Nov. 5 the evening temperature was 37.8°C. Gradually there developed a severe, dry cough. On Nov. 9 the temperature was 38.5°C and the cough was hacking and unproductive. She suffered from insomnia and appetite was poor. She was treated at home.

On Nov. 12, ESR was 30 and chest x-ray was negative. On Nov. 13 she was put on oral penicillin therapy. Four days later the temperature was still elevated at 38.5°C. ESR was 43 on Nov. 16 and chloramphenicol treatment was started on the following day and continued for 5 days. The fever began to abate one day after institution of the treatment but the cough was refractory, until on Nov. 20 it began to improve gradually. On Nov. 28, ESR was 15. The patient was fatigued and in a poor condition for several weeks.

The ornithosis antibody titer was on Nov. 23, 1959, 1: 160; Dec. 12, 1: 160; Jan. 12, 1960, 1: 160; Jan. 23, 1: 120; March 23, 1: 40; May 19, 1: 20.

*Case 34.* Hosp. rep. A 5448/59. This was a 4-year-old boy who lived in an old house where numerous pigeons were fed by the tenants. On Dec. 21, 1959 he became ill with cough and fever up to 39.7°C. On Dec. 23 he was prescribed penicillin. When respiration became short on Dec. 24 he was admitted to the hospital.

On admission T.rect. was 39.8°C. He was fatigued and breathing was short and superficial. Snapping rales were heard throughout the left lung and over the upper part of the right lung anteriorly and posteriorly. ESR was 24 and the white cell count 5,100. X-ray on Dec. 30 showed rather abundant markings in the region of the upper lobes; perihilar markings also were slightly increased throughout.

The patient received penicillin-streptomycin suspension. Temperature became normal in one day and ESR dropped from 24 to 8. On Jan. 1, 1960 he was discharged. Four days later the cough with fever recurred but was cured with renewed medical treatment.

The ornithosis antibody titer was on Dec. 26, 1959, 1: 40; Jan. 1, 1960, 1: 20; Feb. 6, 1: 10; March 18, <1: 10.

*Case 35.* Hosp. rep. PS 553/60 (Pyynikki Hospital, Tampere). A shoe factory worker aged 60 had given no information on possible contact with birds. In early February 1960 he had a common cold, with temperature

elevated up to 39°C for one week. Although the cough persisted he returned to work for 2 weeks, until on Feb. 28 the temperature again rose to 38°C. On March 1 there was cough and dyspnea, and he was sent to the hospital with the diagnosis of Bronchopneumonia incipiens.

On admission T.ax was 38.2°C. His general condition was somewhat serious, and he was feverish and coughed. Considerable whistling rales were heard throughout both lungs. ESR was 36. Chest x-ray on March 4, showed large hilar shadows and increased lung markings. Movement of the right diaphragm was restricted and the costophrenic sinus did not open.

He received penicillin intramuscularly during 8 days. The fever abated in one day and ESR declined from 36 to 23. He was dismissed on March 16 as convalescent.

The ornithosis antibody titer was on March 4, 1960, 1: 10; March 16, 1: 40; April 27, 1: 20.

*Case 36.* Hosp. rep. A 4949/58. A factory worker, female, aged 26, concerning whose contact with birds no information is available became ill on Dec. 17, 1958 with a severe headache and fever of 40°C. The temperature remained elevated for some days. The patient was vomiting on Dec. 19 and 20, and on the latter day was admitted to the hospital.

On admission T.ax. was 39.9°C. Her general condition was rather serious. There was no stiffness of neck or back, and no cold or cough. Percussion and auscultation of the lungs gave a normal finding. ESR was 85 and the white cell count 6,800. Cerebrospinal fluid obtained by lumbar puncture on the day of admission and x-ray on Dec. 23 were negative.

She received chloramphenicol during 8 days. The temperature reverted to normal in one day but a refractory headache continued for nearly 2 weeks. ESR declined by degrees from 85 to 56 to 38. On Jan. 2, 1959 she was discharged as convalescent. The clinician attending her in the ward suggested the possibility of a virus infection giving rise to the headache and tendency to dizziness.

The ornithosis antibody titer was on Dec. 20, 1958, 1: 60 and on Jan. 2, 1959, 1: 60. On Jan. 2, 1959 the WaR, WaR chol., Kahn and Sitolipin tests were negative. No follow-up examination could be performed since the patient had moved to another locality.

*Case 37.* Hosp. rep. A 1663/59. This 51-year-old bank clerk, female, had had no contact with birds. Two days previously her daughter had become ill with cough and fever lasting 4—5 days. On April 12, 1959 the patient developed cough with fever, which remained at 39°C for several days. There was pain in the chest on the left. She received penicillin tablets during 3 days but since the fever and cough persisted her physician sent her to the hospital on April 18.

On admission T.ax. was 38.5°C. She was in a rather serious general condition and was coughing. Moist, medium rales were heard over the postero-basal part of both lungs, being more pronounced on the left. ESR was 41

and the white cell count 8,900. Chest x-ray showed patchy infiltrations in the right lung, especially in the basal part.

She received chloramphenicol during 10 days. The temperature came down to normal in 3 days. X-ray on May 2 showed progressing restitution of the large pneumonic infiltration in the parenchyma of the right lower lobe. ESR declined 41—23—19. On May 4 the patient was discharged but resumed her usual work only 6 weeks later.

The ornithosis antibody titer was on April 20, 1959, 1: 60; May 4, 1: 40; May 21, 1: 20; March 10, 1960, 1: 20. On April 20 and May 21 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

The ornithosis antibody titer of the daughter was 1: 5 on March 21, 1960.

*Case 38.* Hosp. rep. A 1838/59. A salesman aged 37 had had no contact with birds. On April 20, 1959 he had a sudden onset of fever, preceded by a period of fatigue of about 2 weeks' duration. After being normal for two or three days, the temperature was again elevated. He had been coughing since April 20 and there was pain in his left side. Beginning with April 26 he received penicillin during 4 days. On April 30 ESR was 106. Chest x-ray showed patchy infiltrations throughout the left lung. He was admitted on April 30.

On admission T.ax. was 37.2°C. His general condition was moderately good but he had a rather severe cough. Some fine rales were heard. ESR was 87 and the white cell count 6,800. In x-ray on May 2 there was seen in the left upper lobe a rather large pneumonic infiltration in the parenchyma, situated around the hilus and extending to the interlobar pleura and cranially over a large area.

The patient received chloramphenicol during 8 days. The fever abated in 2 days. X-ray on May 12 showed decrease of the pneumonic infiltration in the parenchyma. ESR declined 87—50—23. He was discharged on May 13. When examined in the outpatient clinic on May 27 his ESR was 17 and further decrease of the infiltration was observed in the x-ray.

The ornithosis antibody titer was on May 2, 1959, 1: 40; May 27, 1: 60; March 16, 1960, 1: 40. On May 2 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

*Case 39.* Hosp. rep. ESKS 4014/59. There was no information on contact with birds in the case of a laborer's son aged 8, from the rural commune of Joutseno in south-eastern Finland. In the end of April 1959 he had a cough and on May 8 he was febrile. He was admitted to the South Saimaa Central Hospital on May 9.

On admission T.rect. was 39.5°C. His general condition was moderately good, he was coughing, and breathing was labored. There was a relative dullness over the posterobasal part of the right lung from the scapula downwards, the breath sound was depressed and moist rales were heard. ESR was 38 and the white cell count 10,700. Chest x-ray on May 9 revealed infiltration the size of a hen's egg in the parenchyma of the posterior part

of the right lower lobe. On May 14 fluid was observed in the right pleural cavity, extending laterally to the first rib. Mantoux test (0.1 mg) gave an infiltration of  $11 \times 14$  mm. Cultures and guinea pig test from sputum were negative for tbc.

The patient received at first penicillin intramuscularly during 3 days, followed by penicillin-streptomycin suspension during 13 days and penicillin-sulphonamide tablets during 16 days. Finally chloramphenicol was given for one week. The temperature became normal one week after admission. ESR was 100 on May 16, 55 on May 23, and 17 on May 30. In the chest x-ray on May 21 the pleural fluid had diminished to the level of the fourth rib, on May 29 the inflammatory process on the right was less dense, and on June 5 it had improved further. The x-ray finding on June 12 was unchanged from the preceding radiogram, ESR was 9 and the patient was discharged.

The ornithosis antibody titer was on May 11, 1959, 1: 240; May 23, 1: 240; June 5, 1: 80. On May 23 the WaR and WaR chol. tests were doubtful and the Kahn and Sitolipin tests negative.

**Case 40.** Hosp. rep. A 2806/59. This was a chimneysweep's wife aged 28, who frequently went with her family to feed pigeons in the Old Cemetery. At the same time as her children had a cough, she began to cough in early May 1959. In mid-June her temperature was elevated up to  $39^{\circ}\text{C}$ , and she complained of pain in the left side on breathing. At the end of June her physician prescribed penicillin tablets, which she took during 3 days without relief. Since ESR was 84 and chest x-ray showed an infiltration, she was admitted to the hospital on July 3.

On admission she was afebrile but had a cough. Her general condition was moderately good. Percussion and auscultation of the lungs gave normal findings. ESR was 38 and the white cell count 4,300. In chest x-ray on July 6 the left hilus was slightly enlarged, and in the lingula there were some densities, which partly were bandlike and possibly were in part traces of inflammation and in part a pneumonic process undergoing restitution.

The patient received chloramphenicol during one week. ESR declined 38—19—12. On July 14 the roentgenologic findings were unchanged. She was discharged on July 20. When examined in the outpatient clinic on Aug. 20, ESR was 14 and chest x-ray showed almost complete disappearance of the bronchopneumonic bandlike shadows in the left lung.

The ornithosis antibody titer was on July 4, 1959, 1: 60; July 20, 1: 40; March 17, 1960, 1: 20. On July 4 the WaR was doubtful, WaR chol. positive and Kahn and Sitolipin negative.

**Case 41.** Hosp. rep. LLS 1039/59. This was a foreman's young son aged 2 years 4 months, from the rural commune of Sodankylä in Lapland. There was no information concerning contact with birds. On June 26, 1959, the boy was found to be tired, the temperature was  $39.8^{\circ}\text{C}$ , and he was coughing and vomited twice. He received sulphonamides and chloramphenicol, but

since the fever and cough continued he was admitted to the Lapland Children's Hospital on July 5.

On admission T. rect. was 39.5°C. He was in a rather weak condition, had a severe cough, and coarse rales were heard over the upper part of the right lung. ESR was 111 and the white cell count 16,200. X-ray on July 6 showed shadows in the right lung. The basal part of this lung was collapsed, evidently due to fluid surrounding it. X-ray diagnosis was Pneumonia lob. sup. pulm. dx. cum pleurit. Mantoux test (0.01 mg) gave an infiltration 7 × 6 mm. in size. Culture for tbc from the pleural fluid was negative.

The patient received penicillin-streptomycin suspension during 3 weeks, followed by penicillin orally during 4 weeks. The temperature remained febrile during one week and subfebrile during 2 weeks. Chest x-ray on July 18 showed somewhat less fluid. On July 24 the lungs were normal in size. Some fluid was still seen around their borders. A part of the upper lobe was still atelectatic and the remaining part showed compensatory emphysema. On Aug. 14 the shadows in the right lung were greatly diminished in the middle and lower lobes. Air content of the upper lobe was increased, the lobe had expanded, and the surrounding fluid was reduced in amount. ESR declined progressively 111—102—62—13—24—17—11. He was discharged on Aug. 18.

The ornithosis antibody titer was on July 6, 1959, 1: 60; July 15, 1: 80. On July 6 the WaR, WaR chol., Kahn and Sitolipin tests were negative. In view of the long distance from the hospital to the patient's home, no further blood samples were obtained.

*Case 42.* Hosp. rep. A 4310/59. This 4-year-old boy had had no contact with birds. His father was suffering from a cough in the latter part of September, 1959, when the boy became ill with cough and occasional fever. Chest x-ray on Oct. 12 showed density of the hilar regions. Bandlike infiltration was observed in the right middle and lower lobes. There also were some small atelectases. Evidently it was a case of pneumonia, possibly caused by a virus. He was admitted on Oct. 14.

On admission T. rect. was 37.5°C. The patient had a cold and his voice was hoarse. Rales were heard over the lungs, especially over the upper part of the lungs. ESR was 80 and the white cell count 7,800. The temperature remained normal throughout hospitalization. He received penicillin orally during one week. ESR dropped from 80 to 33. The chest x-ray still showed some changes when the boy was discharged on Oct. 21 at his parents' request.

He was re-examined on Nov. 2 at the outpatient clinic. Roentgenologically the situation was improved. The right hilus was rather large and dense; possibly the pleura made a slight curve at this point or there was thickening of the pleura. ESR was 21.

The ornithosis antibody titer was 1: 80 on Oct. 14 and 21, 1959. On Oct. 14 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

*Case 43.* Hosp. rep. A 4730/59. This girl aged 7 played in the autumn of 1959 with young pigeon nestlings, carrying them in a box and feeding them on Porvoo Street. In early September 1959 she had a cough with occasional fever of 38.6°C. The cough continued but she was absent from school only a total of some days. Chest x-ray on Nov. 9 revealed pleural effusion in the left costophrenic sinus and restricted movement of the left diaphragm. The anterobasal segment of the left lung appeared to be atelectatic in part and showed a dense infiltration. The hilar regions were large and rather dense. X-ray diagnosis was Pleuropneumonia l.sin. (tbc?). The girl was admitted on Nov. 11.

She was without fever throughout the period of hospitalization and had no cold or cough. On percussion there was dullness over the lower part of the left lung and some rales were heard over the right lung. ESR was 12 and the white cell count 4,800. The patient received chloramphenicol during one week. ESR declined 12—9—2. X-ray on Nov. 30 showed that the infiltration had disappeared. Very slight hyperplasia of the hilar lymph nodes was seen. The girl was discharged on Dec. 5.

The ornithosis antibody titer was on Nov. 12, 1959, 1: 60; Nov. 21, 1: 40; Nov. 30, 1: 20; Dec. 18, 1: 20; March 18, 1960, 1: 20. On Nov. 12 the WaR, WaR chol., Kahn and Sitolipin tests were negative.

#### 4. CONTROL SERIES OF PATIENTS WITH OTHER DISEASES

The control series consisted of the 125 patients with diseases other than acute respiratory infections who on the establishment of the final diagnosis had to be excluded from the main series. One hundred patients were residents of Helsinki and 25 persons were from other parts of Finland.

There were 53 (42 per cent) female patients and 72 (58 per cent) male patients. Children numbered 70 (56 per cent) and adults 55 (44 per cent, table 25). The youngest patient was 3 months and the oldest 84 years of age.

The diagnoses included a number infectious diseases of various kinds (table 26).

The second serum of 9 patients, 5 of whom were children, had a positive ornithosis antibody titer (table 27). In 1 case a twofold increase and in 3 cases a twofold decrease was seen. In these 9 cases the diseases were fever of unknown origin in 2 cases and rheumatic fever, acute gastroenteritis, salmonellosis, lymphadenitis, spontaneous pneumothorax, carcinoma of the lung, and rheumatoid arthritis in 1 case each.

TABLE 25

AGE DISTRIBUTION OF PATIENTS IN THE CONTROL SERIES

Age, yrs.	No. of Patients
Under 1	6
1—5	30
6—10	23
11—15	11
16—20	3
21—30	5
31—40	12
41—50	9
51—60	9
61—70	10
Over 70	7
Total	125

TABLE 26

PATIENTS OF THE CONTROL SERIES DISTRIBUTED BY DIAGNOSIS

Diagnosis	No. of Patients
Pleuritis exs.	14
Tub. pulm.	14
Tumor pulm.	13
Febris e causa ignota	12
Gastroenteritis ac.	15
Salmonellosis	4
Tonsillitis, Otitis	15
Meningitis serosa	5
Arthritis rheum.	3
Other	30
Total	125

TABLE 27

PATIENTS OF THE CONTROL SERIES DISTRIBUTED BY ORNITHOSIS ANTIBODY TITER

Patients	Ornithosis CF Titer						Total
	<1:10	1:10	1:15	1:20	1:30	1:40	
Number	116	2	2	2	2	1	125

The highest titer, 1: 40, and a twofold decrease were seen in a child with the diagnosis of rheumatic fever. The diagnosis on which he was admitted to the clinic was subacute respiratory infection, and his sister was also ill at home with cough. It does not appear impossible that the patient had concurrently two infectious diseases.

#### DISCUSSION

It was observed in the present investigation that the ornithosis virus gives rise to pneumonia and mild acute respiratory tract infection in Helsinki and certain other localities in different regions of Finland. No difference was seen in the incidence of ornithosis antibodies in residents of Helsinki and those of other regions; however, cases of acute ornithosis were significantly more numerous in Helsinki than elsewhere. This may possibly be ascribed to the fact that samples from the Aurora Hospital in Helsinki were more systematically collected than those from other hospitals.

During the time that the present investigation was being carried out there was no noteworthy epidemic caused by a respiratory virus in Finland. Minor epidemics were an influenza A2 epidemic in the early spring of 1959 (98) and an unusually large number of cases due to adenovirus 7 in the late summer of the same year, both in Helsinki. The latter was chiefly encountered in children, in many of whom the predominant symptoms were gastrointestinal or even of meningismus type. The period of investigation therefore coincides with a quiet period from an epidemiologic point and thus probably provides a suitable background for an evaluation of the role of the ornithosis virus as an etiologic factor in pneumonia in Helsinki; ornithosis, as is known, rarely gives rise to epidemics. A valuable asset to this work was this laboratory's close connection with the hospital where, as far as is possible, most cases of pneumonia among Helsinki inhabitants requiring hospitalization are treated. It was found that 5.6 per cent of the patients with pneumonia who were being treated at the Aurora Hospital during this period and on whom the serological examination could be made had ornithosis in the acute stage. This corresponds well with the incidences of 5.7 per cent and 4.2 per cent in Denmark and England, respectively (122, 123, 124, 129).

It does not seem possible to present any figures concerning the proportion of mild acute respiratory infections caused by the ornithosis virus, since the patients in this group could not be examined systematically.

The ornithosis virus appeared to affect all age groups, with the exception of infants. It differs in this respect from, for example, adenovirus infection, as a result of which high antibody titers are frequently encountered even in babies. Children of elementary school age (6—10 years) were found to have ornithosis antibodies as frequently as adults and formed the largest group (21 per cent) of patients with ornithosis.

The ornithosis virus appeared to give rise to the disease in the late summer (July-August-September) more commonly than in mid-winter. The observation that onset of the disease had occurred in September in 23 per cent of cases is in agreement with the opinion that birds play a role in transmission of the disease. It is a well known fact that birds become infected already as nestlings. At this time they spread the virus to a greater degree than as adult birds,

when the infection is chronic and may even be latent. Close contact with pigeons was reported by 36 per cent of the patients with ornithosis. Similar symptoms at the same time in other members of the patient's family or in other persons at his place of work were reported by 45 per cent of the patients with ornithosis. Interhuman transmission is therefore undoubtedly a circumstance to be noted.

The ornithosis virus appeared to produce rather variable clinical features in the patients observed in the hospital. Nevertheless, most patients had a hard, dry cough, which persisted for weeks. Vomiting and chest pain were fairly common symptoms in the early stage of the disease. A high fever was generally one of the clinical features, although in some patients there was only a slight rise in temperature. A slow pulse rate incompatible with the fever was typical.

Of the usual laboratory examination results, the erythrocyte sedimentation rate rose to very high levels in some untreated cases. After treatment had been begun a relatively rapid decline set in. The white cell count usually was not above normal, and in some cases even was below the normal level.

In the course of the investigation it became clearly evident that the routine Wassermann test may assist in reaching the etiologic diagnosis in the case of patients with pneumonia. The sera of two patients were sent down from another hospital for examination for possible ornithosis, since in addition to having pneumonia these patients gave positive WaR chol. and Kahn tests without a pertinent case history. A high ornithosis antibody titer was established in both patients.

Already in 1932 Forssman (37) in Sweden found in three patients with symptoms from the lungs a non-specific positive WaR which disappeared within a few months. Some years later Fanconi (35) and Hegglin (50) described WaR-positive lunginfiltration as a separate entity. Hegglin and Löffler (51) suggested that the WaR-positive lunginfiltration is caused by the ornithosis virus transmitted by pigeons. Hegglin (52) even stated that WaR-positive ornithosis has a benign clinical picture of its own: Gradual onset of symptoms, extreme fatigue, catarrhal cough, and a subfebrile temperature or no rise in temperature. In the present work 9 patients with WaR-positive ornithosis showed clinical features that resembled this picture. Of these patients 4 reported close contact with pigeons.

In the present work a non-specific positive WaR, WaR chol, and/or Kahn test was found in 34 per cent of patients with ornithosis. It appeared that the WaR became positive 3—4 weeks after onset of the disease and reverted to negative 1—2 months later, while the ornithosis antibody titer usually was still high. The Kahn test became negative more rapidly than the WaR. Brand and Lippelt (14) reported a positive WaR in 28 per cent of 144 patients with ornithosis and Müller and Mannweiler (90) in 13 per cent of 84 patients.

The non-specific positive WaR encountered in one-third of the patients with ornithosis and its persistence for as long as 2 months demands great care in evaluating the results of the WaR tests, especially since ornithosis evidently is more common in Finland than syphilis.

Concerning the ornithosis titers of patients giving a specific positive WaR, Bedson (6) observed already in 1935 that these sera also give a positive reaction with control antigen. The results obtained in the present work point to a possibility that especially an untreated case of tertiary syphilis may give this reaction.

Still more variable than the clinical picture seems to be the roentgenologic appearance of the lungs. In one-half of the patients with ornithosis it corresponded to that of atypical pneumonia. The incidence of atypical pneumonia was large in comparison to 5 per cent of atypical pneumonia in the 893 cases of pneumonia analyzed by x-ray in this hospital in 1956 (110). The roentgenologic finding in the lungs may resemble tuberculous changes or even be tumor suspect. It is self-evident that establishment of the correct diagnosis in these cases is of great importance for the individual patient. It appears probable that patients sent to tuberculosis sanatoriums include every year some who have ornithosis and not tuberculosis. In the author's knowledge is the case of a middle-aged male patient treated in a sanatorium, with bilateral shadows extending from the hilar regions toward the periphery and a positive WaR. Subjectively he was asymptomatic. This was considered to be a case of syphilis of the lungs (1). In Denmark, Tarnowski (113) found ornithosis in 3 patients among 100 on record in tuberculosis district offices. In all cases of infiltration in the lungs of doubtful etiology an examination for ornithosis should be a part of the routine.

Since the clinical picture of ornithosis is so variable the thought is near at hand that there possibly may exist several types of virus in the ornithosis group in the same manner as, for instance, in the adenovirus group, in which at least 24 types have been differentiated so far. Some viruses in the ornithosis group, for example the so-called human pneumonitis viruses, have probably become completely adapted to man. They were isolated in the early 1940's during epidemics in San Francisco, Louisiana and Illinois (28, 94, 137). Contact with birds could not be established in these epidemics. It was also not possible to definitely identify the isolated strains with the ornithosis virus.

Probably the major drawback in diagnosing the ornithosis viruses is the lack of a suitable tissue culture technique, which makes it necessary to differentiate the various types by time-consuming neutralization tests in experimental animals (58). Another difficulty is that patients enter the hospital at a stage when the optimum time for isolation of the virus has already passed long ago. The ornithosis virus probably can be isolated only when samples are systematically collected immediately after suspect cases are admitted. This is shown, among others, by an investigation made in Israel (33).

It has been customary to include the etiologic agent of ornithosis among viruses, even if among the largest viruses. Some workers have spoken of an intermediary form between viruses and Rickettsiae. Others again (18, 74), and especially Bedson (7), who was the first to isolate the agent, are of the opinion that it actually is closer to Rickettsiae. This is most strikingly pointed to by the definite and incontestable effect of antibiotics on the causative agent of ornithosis.

Since possibilities for isolation of the etiologic factor in ornithosis are uncertain in the ordinary routine of a hospital, establishment of the diagnosis must be made on the base of a serologic examination. The use of ornithosis antigen may be advisable, since it reacts with a larger number of serums and in general gives higher titers than lymphogranuloma venereum antigen (15). Strains of avian origin appear to have either greater antigenicity or a broader antigenic pattern than those of mammalian origin (126). The etiologic agents of lymphogranuloma venereum and trachoma also give positive reactions but errors in diagnosis are undoubtedly

precluded by the completely dissimilar clinical features. The absorption technique using specific antigens described in a recent report (105) suggests future possibilities to reach a more accurate diagnosis also by serologic methods.

It has been claimed by some investigators that infections caused by Q fever and adenoviruses cannot always be differentiated serologically from ornithosis (21, 81, 131). The results obtained in the present work do not support these statements.

The so-called anamnestic reactions mentioned in the literature probably refer to a non-specific increase in titer. In two patients in the present series there was recurrence of pneumonia 7 and 11 months after recovery from the illness which had been diagnosed as ornithosis. It was not possible to demonstrate a rise in the ornithosis antibody titer on the second occasion (cases 14 and 18).

In the present investigation, ornithosis antibodies were found in all examined ornithosis patients 2 weeks after onset of the disease. In most cases the antibody titer attained its highest level already during the third week of illness. Since the patients usually have been ill at home for some time before arriving for an examination, two blood samples taken at an interval of 2 weeks should prove sufficient for performance of the examination for ornithosis.

There are reports that tetracycline therapy given soon after the onset of ornithosis is followed by an early and rapid fall in the ornithosis antibody titer (49) or by complete inhibition of antibody formation (83). Opinions to the contrary have also been presented (8). In the present work it was observed that the ornithosis antibody titer was highest in patients who for some time had been ill at home without proper treatment.

Concerning the duration of a positive ornithosis antibody titer it was observed that 5—7 months after onset of the disease no antibodies were present in 25 per cent of patients then examined. One-fifth of those examined 11—17 months after onset had no antibodies and one-half had titer 1: 10. According to the literature, a positive titer may persist for as long as 16 years (23). However, in such cases the possibility of a reinfection cannot be excluded.

## SUMMARY

An investigation was carried out in a series of 758 patients with pneumonia and 236 patients with mild acute respiratory tract infection in Helsinki and in certain other localities in different regions of Finland. Ornithosis in an acute stage was found in 43 patients. They were grouped according to diagnosis as follows: Pneumonia (broncho-, pleuro-) in 35 cases, pulmonary infiltration in 1 case, acute bronchitis in 2 cases, and acute infection (respiratory) in 5 cases. There were 38 patients from Helsinki and 5 patients from other regions of Finland.

Of 539 patients with pneumonia who were residents of Helsinki and under treatment in the Aurora Hospital, 5.6 per cent were found to have acute ornithosis. A total of 14.7 per cent showed signs of previous ornithosis infection. No significant difference was seen in the incidence of ornithosis antibodies in residents of Helsinki and those of other regions.

Children comprised 42 per cent of the ornithosis series. Onset of the disease occurred most commonly in July, August and September. Contact with pigeons was reported by 36 per cent of patients. Similar symptoms were concurrently present in family members or in persons at the patient's place of work in 45 per cent of cases.

Cough was a symptom in 95 per cent of patients with ornithosis. In 77 per cent it lasted for over 2 weeks and in 35 per cent for over 4 weeks. Coryza was present in 57 per cent, pain in the chest in 36 per cent, and vomiting in 33 per cent. In 66 per cent of cases there was high fever; a febrile temperature persisted for less than 2 weeks in 69 per cent. Only a slight rise in temperature was present in 10 per cent of patients. Relative bradycardia was observed in 62 per cent.

Erythrocyte sedimentation rates over 50 mm/1 hr. were noted in 55 per cent. In 70 per cent the white cell count was normal or reduced ( $\leq 9,000$ ). A positive WaR, WaR chol. and/or Kahn test was given by 34 per cent.

Roentgenologically 48 per cent of the patients with ornithosis showed the picture of atypical pneumonia. In the opinion of the roentgenologist, 4 cases were at first tuberculosis suspect and 1 case tumor suspect. Roentgenologic changes were present in 48

per cent of patients for over 6 weeks; these included 17 per cent in whom the changes persisted for over 9 weeks.

In most cases the ornithosis antibody titer reached its highest level already during the third week after onset. No antibodies were found 5—7 months after the acute phase in 25 per cent of the patients, and 11—17 months after onset the titer had dropped to 1: 10 in 50 per cent.

None of the patients with ornithosis showed a significant rise in the adenovirus or Q fever antibody titers.

Penicillin, chloramphenicol or tetracycline therapy appeared to have some effect in the treatment of ornithosis.

## CHAPTER IV

### ORNITHOSIS ANTIBODIES IN PERSONS IN CONTACT WITH BIRDS AND IN CONTROL SUBJECTS

#### MATERIAL

To obtain blood samples for examination of the presence of ornithosis antibodies in owners of canaries and parrots, letters were sent to the mothers of 191 pupils in municipal elementary schools in Helsinki. The list of families to whom letters were addressed was compiled on the basis of interrogation by the school nurses. The children and their parents were asked to come to the outpatient clinic to give blood samples. The requests were sent twice, in March 1959 and February 1960. As a result, 65 blood samples were obtained from 35 children and 30 adults.

The presence of ornithosis antibodies in poultry raisers was also examined. A series of 30 blood samples was obtained in October 1959 from the teachers and pupils of a training course for poultry raisers. Samples from 42 workers on a poultry farm were also received in March 1960.

After a person employed in the city disinfection plant of Helsinki and occasionally occupied in pigeon extermination had been found to have severe pneumonia caused by the ornithosis virus, other employees engaged in similar work were invited for an examination. Twelve present and former pigeon exterminators complied with the request.

For comparison, 3 groups of control persons were collected. For the first group, blood samples were taken from 93 children undergoing treatment in the surgical wards of the Aurora Hospital in February-May 1960. Their distribution by age was as follows: Under 1 year, 4 per cent; 1—5 years, 12 per cent; 6—10 years 40 per cent; 11—15 years, 44 per cent.

The second group consisted of 59 medical students about 20 years of age, who had begun their first course in hospital in January 1960.

In the third group were 998 blood donors, from whom blood samples were taken for ornithosis antibody examination in connection with blood donation in March-August 1959. There were 575 females (58 per cent) and 423 males (42 per cent). From 387 donors (39 per cent) two samples were obtained at an interval of 3-6 months. In cases in which the titer was found to be  $\geq 1:40$  a third sample was requested about 1 year after taking of the first sample.

## RESULTS

### 1. CAGE BIRD OWNERS

Among the 65 owners of cage birds, ornithosis antibodies were found in 5 persons (8 per cent), 2 of whom were children and 3 adults (table 28). Thus 6 per cent of the children and 10 per cent of the adults who were in contact with cage birds had a positive ornithosis antibody titer. No significant difference was observed when the cage bird owners were compared with children in the surgical wards and with blood donors ( $P > 5$  per cent).

### 2. POULTRY RAISERS

In 3 (10 per cent) of the 30 samples obtained from the poultry raisers' school the ornithosis antibody titer was  $\geq 1:10$  (table 28). Antibodies were also found in the samples from 14 (33 per cent) of the 42 workers on a large poultry farm. When compared with the incidence in blood donors (14.3 per cent) the difference is significant ( $P < 1$  per cent).

### 3. PIGEON EXTERMINATORS

In the series of 12 pigeon exterminators 4 persons (33 per cent) had a positive ornithosis antibody titer (table 28). There was no significant difference when this result was compared with that in blood donors ( $P > 5$  per cent). This was probably due to the small series. A noteworthy difference in comparison to the above described two groups was the presence of the high titers of 1:80 and 1:60 in two persons. The first mentioned had pneumonia of long duration prob-

ably caused by the ornithosis virus (Chapter III B. 3, case 3). The latter had about a year earlier had a cough which persisted for several months; however, he had been working all the time.

#### 4. CONTROL PERSONS

The ornithosis antibody titers found in the control series are shown in table 28.

TABLE 28.

HEALTHY CONTROL SERIES AND PERSONS IN CLOSE CONTACT WITH BIRDS DISTRIBUTED BY ORNITHOSIS ANTIBODY TITER

Group	Ornithosis CF Titer										Total	
	<1:10	1:10	1:15	1:20	1:30	1:40	1:60	1:80	≥1:10	≥1:20		
Age bird owners:												
Children .....	33	1	—	1	—	—	—	—	2	1	—	35
Adults .....	27	—	—	2	1	—	—	—	3	3	—	30
Poultry raisers:												
Poultry school pupils	27	1	—	1	1	—	—	—	3	2	—	30
Professionals .....	28	8	1	3	1	1	—	—	14	5	1	42
Pigeon exterminators....	8	—	—	1	1	—	1	1	4	4	2	12
Healthy controls:												
Children (surgical cases)	86	4	—	2	—	—	—	1	7	3	1	93
Medical students.....	55	—	—	1	3	—	—	—	4	4	—	59
Blood donors .....	855	82	13	34	2	9	1	2	143	61	12	998
									14.3 %	6.1 %	1.2 %	

In the series of 93 children undergoing treatment in the surgical wards 7 children (8 per cent) had ornithosis antibodies. One child had a titer as high as 1: 80. This was a 7-year-old boy with cough and coryza who had been admitted because of concussion of the brain. His parents were suffering from a mild acute respiratory infection at the time.

Among the 59 examined medical students who previously had not worked in hospitals, 4 students (7 per cent) had a positive titer.

In the group of 998 blood donors 143 persons (14.3 per cent)

TABLE 29  
AGE DISTRIBUTION OF BLOOD DONORS

Age, yrs.	<21	21-30	31-40	41-50	51-60	61-70	70	Total
Blood donors:								
Number ..	11	172	205	266	270	68	6	998
Per cent ..	1	17	20	27	27	7	1	100

were found to have ornithosis antibodies in the first sample. Among the latter, 61 donors (6.1 per cent of the group) had a titer of  $\geq 1: 20$  and 12 donors (1.2 per cent)  $\geq 1: 40$ .

The age grouping of the blood donors is shown in table 29. It is seen that 74 per cent of them were aged 31-60 years. The blood donors also showed no difference in the incidence of ornithosis antibodies in the different age groups, as is seen in table 30, in which the positive titers are correlated to the age of patients with pneumonia or mild acute respiratory tract infection.

TABLE 30  
CORRELATION OF ORNITHOSIS ANTIBODY TITER  $\geq 1: 10$  WITH AGE OF BLOOD DONORS AND OF PATIENTS WITH PNEUMONIA AND WITH MILD ACUTE RESPIRATORY TRACT INFECTION

Age, yrs.	21-30	31-40	41-50	51-60	61-70	<70	Total
All blood donors .....	172	205	266	270	68	6	987
Donors with titer $\geq 1: 10$ :							
Number .....	19	28	43	42	10	1	143
Per cent of age group	11	14	16	16	15	17	
All patients with pneumonia and mild acute respi. tract infection ..	46	60	79	102	60	37	384
Patients with titer $\geq 1: 10$ :							
Number .....	5	15	16	22	6	6	70
Per cent of age group	11	25	20	22	10	16	

On examination of the results of tests for antibodies in the blood donors from whom two samples were obtained it is observed that in 306 cases (79 per cent) the titer was the same in both samples (table 31). Higher titers were seen in the second sample from 53 persons (14 per cent). In 28 cases (7 per cent) it was higher in the first than in the second sample.

TABLE 31  
BLOOD DONORS DISTRIBUTED BY ORNITHOSIS ANTIBODY TITER IN FIRST AND SECOND SERUMS

Titer Level in 2nd Serum	Ornithosis CF Titer								Total
	<1:10	1:10	1:15	1:20	1:30	1:40	1:60	1:80	
Titer Level in 1st Serum									
<1:10	279	22	6	8	1	7	—	—	323
1:10	11	12	1	2	1	—	—	—	27
1:15	1	—	2	—	—	1	—	—	4
1:20	2	5	2	8	2	1	—	—	20
1:30	—	1	—	1	—	—	—	1	3
1:40	2	—	—	1	1	5	—	—	9
1:60	—	—	—	—	—	—	—	—	—
1:80	—	—	—	—	—	—	1	—	1
Total	295	40	11	20	5	14	1	1	387

In 7 blood donors the rise in the titer from the first to the second serum was fourfold, being from <1: 10 to 1: 40. One donor had a titer of 1: 60 and one donor 1: 80. It seemed obvious that these 9 blood donors had become infected by ornithosis virus during the observation period.

Of the 23 blood donors whose ornithosis antibody titer in the first and second serums was  $\geq 1: 40$ , 13 arrived for examination one year after taking of the first sample (fig. 12). Two of these

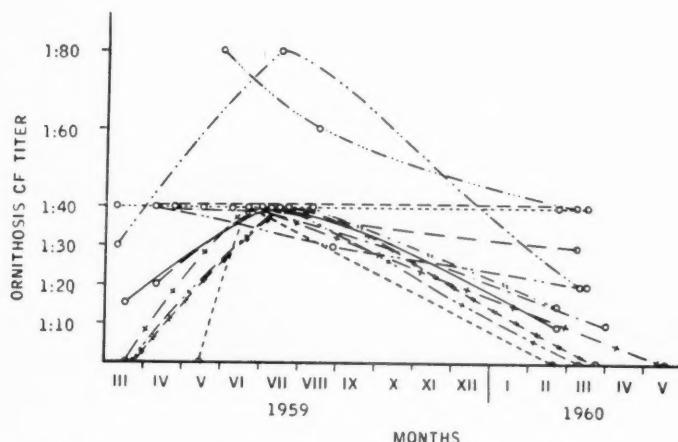


Fig. 12. — Ornithosis antibody titers of 13 blood donors followed for one year

persons had the same titer of 1: 40 in the three samples, the third serum of 4 donors had a lower titer than the previous samples, and 7 persons, corresponding to about one-half of this group, showed a rise in titer from the first to the second sample, and then a decline. An interesting observation was that highest titers were reached in summer.

The ornithosis antibody studies of the blood donors were made in January-February 1960. The paired serums were tested at the same time.

At a later time, WaR, WaR chol., Kahn and Sitolipin tests were made of the serums of 14 blood donors whose ornithosis antibody titer had been found to be  $\geq 1: 40$ . Five of these persons (36 per cent of blood donors with a high titer and 0.5 per cent of all blood donors) gave a positive WaR, WaR chol. and/or Kahn test.

#### DISCUSSION

The present investigation revealed that the incidence of signs of an earlier ornithosis infection was no higher in owners of cage birds in Helsinki than in the control groups. Children who owned cage birds showed a positive titer in 6 per cent and adults in 10 per cent, the incidences in the control series being 8 per cent and 14 per cent, respectively. No suspect cases of ornithosis were found among owners of canaries and parrots. Accordingly, cage birds do not appear to be a significant source of ornithosis infection in Finland.

Ornithosis antibodies were found in 10 per cent of persons training to become poultry raisers and their teachers. On the other hand, 33 per cent of persons who already were occupied as poultry raisers had signs of having been infected with the ornithosis virus. The poultry farm where these poultry raisers were working occasionally imported poultry from other countries. The incidence of 33 per cent is significantly higher than that of 14 per cent in the control series. In seeking sources of ornithosis infection, chickens and turkeys should be held in mind also in Finland.

In studies of poultry raisers in the United States, an ornithosis antibody titer of  $\geq 1: 16$  was found in 7.4 per cent of 339 persons (44) and 14.7 per cent of 109 persons (104). Titer  $\geq 1: 10$  was obtained in 30 per cent of 29 poultry raisers (75). A number of

ornithosis epidemics on turkey farms in Texas have been described (e.g., 70, 108). Two hundred cases were reported there in 1954.

The serologic signs of an earlier ornithosis infection seen in 33 per cent of 12 pigeon exterminators point to the probability that pigeons are a noteworthy reservoir of the ornithosis virus in Helsinki. Evidence in support of this opinion is the acute ornithosis in one of the pigeon exterminators.

On examination of the results of this investigation attention is drawn to the fact that as many as 14 per cent of Helsinki residents of mature age had been in contact with the ornithosis virus. This seems to indicate that ornithosis is a common infectious disease in Helsinki. Since the ornithosis antibodies seem to disappear in some cases from the patient's blood already within 6 months after infection, it appears probable that every person is reinfected by a virus of the ornithosis group a number of times during his lifetime. The opinion has been expressed in the literature that probably most patients recovering from psittacosis are resistant to reinfection (86). Second attacks have nevertheless been observed (119, 128). Recovery from an inapparent infection with turkey virus probably gives no protection against psittacosis virus. These observations are compatible with the recognition that members of the group possess species-specific antigens (86).

Since blood donors are in general in comparatively good health with the exception of occasional »colds», it may be assumed that viruses of the ornithosis group give rise in most cases only to a condition like common cold, to which the patient usually pays no serious attention. Evidently it frequently is cured without antibiotic therapy. However, this group of viruses causes yearly the loss of a considerable number of working days and economic losses.

The interesting observation was made in blood donors that ornithosis infection probably is especially common in summertime (fig. 12). Further evidence of this was the observation that 14 per cent of the blood donors from whom two blood samples were obtained had a higher titer in the second serum taken in summer, and that in 7 per cent only it was higher in the first sample taken in the early spring.

## SUMMARY

In 65 owners of cage birds the ornithosis antibody titer was  $\geq 1: 10$  in 8 per cent of the group, being 6 per cent in children and 10 per cent in adults. In 42 persons occupied in poultry raising the titer was positive in 33 per cent. It also was positive in 33 per cent of 12 pigeon exterminators. One person in the last mentioned group had acute ornithosis.

In the control series, ornithosis antibodies were found in 8 per cent of 93 children, 7 per cent of 59 medical students, and 14 per cent of 998 blood donors. Titer  $\geq 1: 20$  was seen in 6 per cent of the blood donors. A non-specific WaR, WaR chol. and/or Kahn test was given by 36 per cent of blood donors with a high ornithosis antibody titer and 0.5 per cent of all blood donors.

Cage birds do not appear to be a noteworthy source of ornithosis infection in Finland. On the other hand, domestic poultry, at least in some parts of Finland, and pigeons in Helsinki evidently are infected with the ornithosis virus.

It appears probable that viruses of the ornithosis group cause infection in Helsinki residents during summer months especially. Frequently the infection may be subclinical.

## CHAPTER V

### ORNITHOSIS ANTIBODIES IN PIGEONS IN HELSINKI

#### MATERIAL

In the period September 19, 1959—February 22, 1960 the city disinfection plant of Helsinki sent weekly an average of 50 pigeons for use in the present work. The total number of pigeons was 646. The birds were of all sizes, including young birds. The greater part were adults.

The pigeons had been caught in all districts of the city. Since pigeons have the habit of nesting throughout the year in one place, for example an attic, and form a kind of large families living in the same neighborhood, 164 pigeons were examined separately according to 11 locations (parks, squares and streets) in various parts of the city.

#### Taking of Samples from Pigeons

The following technique was regarded as the most time-saving in taking blood samples from the pigeons. The bird, under deep ether anesthesia, was fastened onto an examination board with two large pins passed through the extended wings. The breast and belly were plucked and the breast was cut open with scissors slightly to the left of the sternum, taking care not to damage the heart and the liver. Then 3—5 ml of blood was drawn from the heart with a 10 ml syringe and a big needle.

In carrying out this procedure a distribution of work was used in which one person anesthetized the pigeons, another person prepared them, and a third drew the blood samples. The workers wore masks and rubber gloves. Immediately after completion of the procedure the work clothes were discarded. Ultraviolet lamps were then lighted in the room.

## RESULTS

#### DIRECT CF TECHNIQUE

The serums from 646 pigeons were examined by the direct CF technique, using complement obtained from the laboratory's guinea-pigs or commercial guinea-pig complement. No difference was

found in the serviceability of the two complements. On the other hand it was observed that even a slight excess of complement readily rendered the series too non-sensitive and gave a negative result with pigeon serums that on other days gave antibody titers which sometimes were very high.

In the series of 646 pigeons, the ornithosis antibody titer of  $\geq 1: 10$  was found in 181 birds (28 per cent, table 32). These included 120 pigeons with high titers  $\geq 1: 40$ . Fig. 13 shows the ornithosis antibody titer level in pigeons and in patients with respiratory infection.

In 164 pigeons caught in different locations in the city the incidence of ornithosis antibodies varied in the range 15—55 per cent

TABLE 32  
PIGEON SERUMS TESTED BY DIRECT CF TECHNIQUE, DISTRIBUTED BY ORNITHOSIS  
ANTIBODY TITER

No. of serums	Ornithosis CF Titer												Total
	<1:10	1:10	1:15	1:20	1:30	1:40	1:60	1:80	1:120	1:160	1:240	1:320	
465	18	6	23	14	25	10	35	5	17	5	24	646	

TABLE 33  
ORNITHOSIS ANTIBODIES IN PIGEONS IN DIFFERENT DISTRICTS OF HELSINKI,  
DETERMINED BY THE DIRECT CF TECHNIQUE

Place where Pigeons Caught	Total No. of Pigeons	Ornithosis CF Titer $\geq 1:10$	
		No. of Pigeons	Per cent
Franzén Street .....	18	7	39
Aleksis Kivi Street .....	10	3	30
Atheneum Art Museum Garden .....	22	8	36
Kallio Library Square .....	16	5	31
Garden of National Pensions Fund Building	15	4	27
Vaasa Street .....	15	4	27
"    " .....	11	3	27
Karstula Road .....	13	2	15
St. Paul's Church Park .....	11	6	55
Alppi Street .....	15	4	27
Square of Three Smiths .....	18	3	17
Total	164	49	30

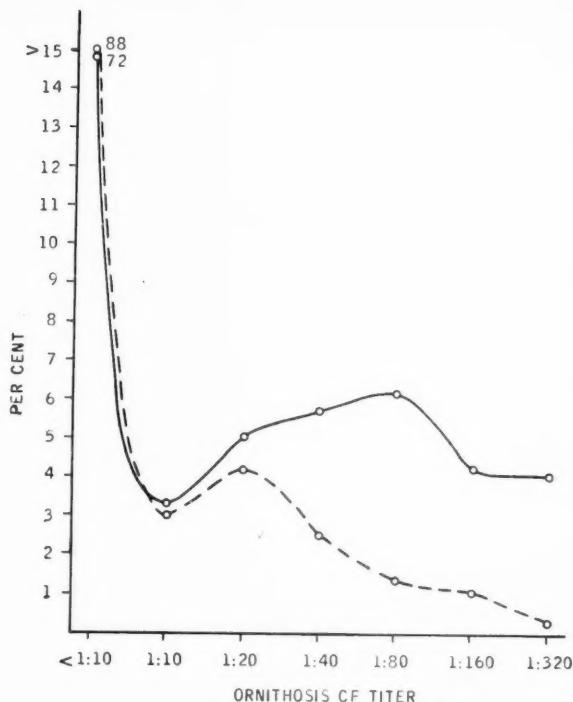


Fig. 13. — Serums of pigeons and of patients with respiratory infection, distributed by ornithosis antibody titer

— = Pigeons  
 - - = Patients with respiratory infection

(table 33). Using the direct CF technique, an average of 30 per cent of the pigeons showed signs of ornithosis infection.

The prozone phenomenon was observed in 21 pigeon serums; in 8 of these it was present only in the first examination of the serum.

#### INDIRECT CF TECHNIQUE

The indirect CF technique was used for examination of 95 pigeon serums from 8 locations in different districts of Helsinki. In 60 birds (63 per cent) an antibody titer of  $\geq 1:10$  was observed (table 34).

In this group of 95 pigeons, 23 birds (24 per cent) had given a positive titer by the direct CF technique. Ornithosis antibodies were found in 75 pigeons (79 per cent) by either or both techniques.

TABLE 34  
RESULTS OF ORNITHOSIS ANTIBODY DETERMINATIONS FROM 95 PIGEON SERUMS  
BY DIRECT AND INDIRECT CF TECHNIQUE

Serum No.	Ornithosis CF Test		Serum No.	Ornithosis CF Test	
	Direct	Indirect		Direct	Indirect
488	1:30	<1:10	542	<1:10	<1:10
490	<1:10	1:10	544	<1:10	≥1:40
492	<1:10	≥1:40	545	1:20	1:20
493	<1:10	1:30	546	<1:10	≥1:40
494	<1:10	<1:10	547	1:160	<1:10
495	≥1:320	1:10	548	<1:10	<1:10
496	<1:10	≥1:40	549	<1:10	≥1:40
497	<1:10	<1:10	550	<1:10	1:30
498	<1:10	≥1:40	551	<1:10	≥1:40
500	<1:10	<1:10	555	1:60	<1:10
501	<1:10	≥1:40	556	<1:10	≥1:40
502	1:160	<1:10	557	<1:10	≥1:40
503	1:160	<1:10	560	<1:10	≥1:40
504	1:120	<1:10	561	<1:10	≥1:40
505	1:80	<1:10	562	<1:10	≥1:40
506	<1:10	1:20	563	<1:10	≥1:40
507	<1:10	<1:10	564	<1:10	<1:10
508	<1:10	≥1:40	565	<1:10	≥1:40
509	<1:10	<1:10	566	<1:10	≥1:40
510	≥1:320	<1:10	570	<1:10	≥1:40
511	1:40	<1:10	571	1:10	<1:10
512	<1:10	1:15	572	<1:10	<1:10
513	<1:10	≥1:40	574	<1:10	≥1:40
514	<1:10	≥1:40	575	<1:10	<1:10
515	<1:10	<1:10	577	<1:10	≤1:40
516	1:160	1:20	578	<1:10	≤1:40
517	<1:10	≥1:40	581	<1:10	≤1:40
518	1:160	1:20	582	<1:10	≤1:40
519	<1:10	≥1:40	583	<1:10	≤1:40
520	<1:10	≥1:40	587	<1:10	≤1:40
521	≥1:320	<1:10	588	1:40	<1:10
522	<1:10	≥1:40	590	<1:10	≥1:40
523	1:60	1:20	591	<1:10	≥1:40
524	<1:10	≥1:40	594	<1:10	≥1:40
525	<1:10	≥1:40	595	<1:10	≥1:40
526	1:30	<1:10	596	<1:10	<1:10
527	≥1:320	<1:10	597	<1:10	≥1:40
528	<1:10	≥1:40	598	<1:10	≥1:40
529	<1:10	<1:10	599	<1:10	≥1:40
530	<1:10	1:20	601	<1:10	≥1:40

Serum No.	Ornithosis CF Test		Serum No.	Ornithosis CF Test	
	Direct	Indirect		Direct	Indirect
531	<1:10	<1:10	603	1:40	1:20
534	<1:10	≥1:40	605	<1:10	≥1:40
535	<1:10	<1:10	606	<1:10	≥1:40
536	<1:10	<1:10	607	1:40	≥1:40
537	<1:10	≥1:40	610	<1:10	≥1:40
539	<1:10	<1:10	612	<1:10	≥1:40
540	<1:10	<1:10	614	1:40	<1:10
541	<1:10	<1:10			

488—505 From Franzén Street  
506—515 " Aleksis Kivi Street

516—537 " Atheneum Art  
Museum Garden  
539—551 " Kallio Library Square

555—566 From Garden of National  
Pensions Fund  
Building  
570—588 " Vaasa Street  
590—599 " Karstula Road  
603—614 " St. Paul's Church  
Park

### Infectivity of Pigeons

The blood samples from the pigeons were taken in the animal autopsy room of the laboratory. When the work with pigeons had been in progress for about 6 weeks a member of the laboratory personnel had an onset of severe and persisting bronchitis, caused by the ornithosis virus (Chapter III B. 3, case 33). She had not worked with the birds and ornithosis was therefore not suspected at first. She was at work for a number of days although coughing badly.

When the diagnosis of ornithosis had finally been established in this case the ornithosis antibodies of 17 other laboratory workers were examined. Only one of them had titer 1: 15. About 10 days after onset of the disease in the other laboratory worker he complained of fatigue and a slightly sore throat for a day or two. Three months later his antibody titer was 1: 10. These two persons were working in close collaboration in the laboratory.

These experiences in our laboratory seem to indicate that viruses of the ornithosis group encountered in pigeons in Helsinki are not comparable in infectivity and virulence with the virus strains in parrots. Among the examined 18 persons working in the laboratory only 2 had symptoms pointing to ornithosis.

### DISCUSSION

According to the present investigation, 28 per cent of pigeons in Helsinki show signs of ornithosis infection when examined by the direct complement fixation technique. In pigeons caught in dif-

ferent parts of the city the incidence varied in the range of 15 to 55 per cent. Using the indirect CF technique, ornithosis antibodies were found in 63 per cent of the pigeons. By either or both CF techniques, 79 per cent of the birds had a positive titer.

From these results it would seem that nearly all the pigeons in Helsinki are infected with the ornithosis virus. Bearing in mind that the number of pigeons in this city of 400,000 inhabitants is estimated to be about 30,000 (12), it is evident that pigeons are a considerable infective risk to the inhabitants by soiling parks, market places, balconies and window sills. It also must be held in mind that the ornithosis virus is highly resistant to drying.

Fortunately the ornithosis virus in pigeons in Helsinki is not equal in the infectivity and virulence to the virus strains present in parrots. Evidence speaking for this is the fact that an epidemic did not break out in the laboratory, concerning which there was some apprehension when the work was begun. In the literature are described several laboratory epidemics, for instance one in Washington in 1930, when the virus infected 11 members of a laboratory personnel of which only 2 had been in contact with diseased parrots (99).

A comparison of the results of the ornithosis antibody examinations of pigeons in Helsinki with those published from other countries shows that they are of the same order of magnitude. When studied by the direct CF technique, 52 per cent of examined pigeons in Oslo were found to have ornithosis antibodies (117), 30 per cent in Copenhagen (123), 24 per cent in Hamburg (130), 25 per cent in Jerusalem (9), 35 per cent in Tokio (63) and 25 per cent of 4,089 pigeons examined in the United States (85). When both the direct and the indirect CF techniques were used, antibodies were found in 60—80 per cent of examined pigeons in the United States (85) and in 84 per cent in Australia (22). Pigeons with »closed« latent infections may have no CF antibodies (84).

The indirect CF technique was developed by Rice in 1948 (102, 103) when examining chicken serums. The inhibitory substance might be of a type similar to monovalent antibody which combines with homologous antigen but forms an aggregate too small to fix complement (102). It seems possible that certain human cases of psittacosis might produce only inhibitory antibodies and the infection would not be detected in the routine CF test (106).

## SUMMARY

When 646 pigeons caught in different districts of Helsinki were examined by the direct CF technique, ornithosis antibodies were found in 28 per cent of the birds. Examination of 95 pigeons caught in 8 places in Helsinki revealed antibodies in 25 per cent by the direct CF technique and in 63 per cent by the indirect CF technique. When both techniques were used, signs of infection with ornithosis virus were found in 79 per cent of the pigeons in one or both of the tests.

In the course of the work with pigeons, one laboratory worker not participating in handling of the birds contracted ornithosis.

## CHAPTER VI

### GENERAL CONCLUSIONS AND DISCUSSION

In the present investigation the following answers were obtained to the questions posed at the outset of the work:

1. The ornithosis virus produces pneumonia and other respiratory infections in Helsinki and in certain other examined localities in different regions of Finland. Thus 5.6 per cent of patients with pneumonia admitted to a hospital in Helsinki were considered to have been infected by the ornithosis virus. The clinical features of the disease were variable, ranging from mild acute respiratory infection to severe pneumonia.

2. The incidence of signs of previous infection with the ornithosis virus was higher in poultry raisers and pigeon exterminators than in other persons examined. On the other hand, owners of cage birds did not show such a difference from the control series.

3. Nearly all the pigeons in Helsinki seemed to be infected with the ornithosis virus. They should be considered a very significant source of this infection.

In addition to the results of the examination of pigeons (pp. 96, 97), the findings in ornithosis antibody examinations of pigeon exterminators and poultry raisers (p. 88) and a case of ornithosis diagnosed in a pigeon exterminator (pp. 88, 89) pointed to the part played by birds in the transmission of ornithosis virus infection. Facts in accordance with this were contact with birds reported by several patients with ornithosis (p. 37) and the finding that the ornithosis virus appeared to cause infection in the late summer more frequently than in winter (p. 37).

On the other hand, the common occurrence of interhuman transmission of ornithosis was indicated by several familial cases (p. 37). Furthermore, were ornithosis not transmitted from man to man it would have been expected that signs of infection with the ornithosis virus would more frequently have been seen in children playing in courtyards and streets than in adults.

Since an epidemic did not break out in the laboratory during work with the pigeons, the infectivity and virulence of the ornithosis virus present in pigeons is evidently not comparable to that of the virus strains in parrots. Such an epidemic would have been promoted by the inadequate possibilities for isolation of the workers handling pigeons, since the work was carried out in a bacteriologic diagnostic laboratory. Only one member of the laboratory personnel became infected with the ornithosis virus (p. 99), and the incidence of ornithosis antibodies in the entire laboratory personnel was not higher than in a normal population (p. 99).

The onset of a disease in a person is influenced not only by the infectivity and virulence of the etiologic agent, but also by other factors such as massiveness of the infection, resistance of the individual to disease, and, in the case of a virus disease, a possible secondary bacterial infection. Upon these factors depends also the severity of the disease. Infection caused by the ornithosis virus alone is possibly subclinical in many cases. Indications of this were the cases of ornithosis encountered in control subjects (pp. 89, 91) as well as the high incidence of ornithosis antibodies in the control series (p. 89). It seems probable that ornithosis is a considerably more common disease than previously has been assumed.

Since ornithosis antibodies were found in all age groups (p. 37) and since, on the other hand, the antibodies seemed to disappear relatively rapidly after recovery from ornithosis (pp. 50, 51), it appears probable that every person is infected with the ornithosis virus a number of times in his lifetime. It may indeed be assumed that, in similarity to the adenoviruses, there are a number of different types of ornithosis virus, which have a common complement-fixing group antigen as well as type-specific antigens. Some types of ornithosis virus may have become adapted to man. The term para-ornithosis proposed in the literature (31) would seem to be appropriate for the type producing the mildest form of the disease.

The great variability of the clinical features of the disease depends probably on difference in ornithosis virus types. For example, some patients were entirely free from cough (p. 39) and others from fever (p. 40). Characteristic of cases admitted to the hospital was the refractory persistence of the disease, resulting in incapacity to work for a number of weeks (p. 44). However, antibiotic therapy

appeared to have an effect on the course of the disease even in the most severe cases (p. 55, 56).

The roentgenologic finding in pneumonia caused by the ornithosis virus resembled in many cases that of atypical pneumonia; hilar hyperplasia, atelectasis and signs of pleural effusion were observed frequently (pp. 41, 42). Since in some cases the roentgenologic finding in the lungs made tuberculosis or a tumor suspect (p. 42), an examination for ornithosis should be a routine procedure in all cases of pulmonary infiltration of doubtful etiology.

Of the laboratory examinations the erythrocyte sedimentation rate reached fairly high values, while the white cell count generally was within normal limits or, in some cases, reduced (p. 42). The high incidence of a non-specific positive WaR, WaR chol. and/or Kahn test is a finding that should help in establishing a correct diagnosis of the etiology (pp. 52, 54). On the other hand, the persistence of a positive WaR for as long as 2 months after the acute stage of the disease, and the occurrence of ornithosis as a mild and evidently common disease calls for caution in making a diagnosis of syphilis on basis of the serological tests. In Finland, ornithosis possibly is the most frequent cause of a non-specific positive Wassermann reaction (92).

Since an untreated case of tertiary syphilis gave a positive reaction with both ornithosis antigen and control antigen (p. 54), the use of a control antigen is necessary to preclude an erroneous diagnosis of ornithosis. The lack of a commercial control antigen which could be obtained together with the ornithosis antigen is a circumstance that requires correction.

Examination with ornithosis antigen, using the complement fixation (CF) technique, may be considered a good and adequately specific reaction for the establishment of a diagnosis of ornithosis. The clinical features produced by the trachoma and lymphogranuloma venereum viruses, which completely differ from that produced by other viruses of the same group giving a positive reaction, should prevent confusing the diagnoses. No cross reaction was seen between the ornithosis, adeno- and Q fever viruses when examined by the CF technique (pp. 54, 55), nor were non-specific increases seen in the titer (p. 84).

Since in most cases the ornithosis antibody titer appeared to attain its highest level during the first three weeks after onset

(p. 49), two blood samples taken at an interval of 2 weeks early in the disease will be sufficient for establishment of the diagnosis. The highest antibody titers were seen in patients who had been ill at home for a long time without proper treatment (p. 50). Following the acute stage of the disease there was a relatively rapid fall in the titer, and 6 months after onset no antibodies were seen in a part of the patients with ornithosis.

The direct CF technique was used in examination of the serums of patients and control subjects. The indirect CF technique used additionally in examination of the pigeons raised the positive reactions over twofold (p. 97). The opinion has been expressed in the literature (106) that infection with the ornithosis virus also in man is occasionally followed by development of non-complement-fixing antibodies. Thus it is possible that the incidences of ornithosis antibodies observed in human subjects in the present investigation are minimum values only. In this respect further investigation is necessary in order that we may form an opinion of the significance of the ornithosis virus as a cause of disease and reason for loss of working days.

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